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ABSTRACT

Environmental education has been incorporated into both the school curriculum and teacher education for vocational agriculture in Michigan. It is, for the most part, not a separate program area but is integrated into production units. The same instructional method for teaching environmental education is followed as for any other topic, predominantly problem solving. The agricultural teacher education program at Michigan State University contains significant amounts of emphasis on environmental education through specific courses and integrated parts of other courses. Major achievements in the incorporation of environmental education into agricultural education are: (1) curriculum revision and inservice education in teacher education; and (2) curriculum revision and Future Farmers of America contests and awards for students. Major constraints include insufficient course offerings and local school district autonomy. Strategies for incorporating environmental education into agricultural education are active state support, leadership, expanded knowledge base of teachers, and curriculum development. Documents and activities need to be developed to support teachers and assist regional leaders. (Appendixes include requirements for the major in natural resources and environmental education and three course descriptions.) (YLB)

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Unesco-UNEP International Environmental
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Environmental
Education Series **28**

ENVIRONMENTAL EDUCATION IN VOCATIONAL AGRICULTURE CURRICULUM AND AGRICULTURE TEACHER EDUCATION IN MICHIGAN, U.S.A., A CASE STUDY

A Discussion Document for Unesco Training Seminars
on Environmental Education

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28	Environmental Education in Vocational Agriculture Curriculum and Agriculture Teacher Education in Michigan, U.S.A., A Case Study	1988

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Environmental
Education Series **28**

Environmental Education in Vocational Agriculture Curriculum and Agriculture Teacher Education in Michigan, U.S.A., a Case Study

Prepared at Michigan State University,
College of Agriculture
and Natural Resources by:
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Division of Science, Technical
and Environmental Education

4

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Table of Contents

Preface i

Introduction 1

Educational System 2

Educational System in Michigan 4

Vocational Education in Agriculture in Michigan 10

    Curriculum 14

    Teacher Education 24

Environmental Education 29

    In Vocational Agriculture 29

    In Agricultural Teacher Education 42

Major Achievements in the Incorporation of Environmental Education in Agricultural Education 62

    Agricultural Teacher Education 62

    Secondary Vocational Agriculture 65

Major Constraints in the Incorporation of Environmental Education in Agricultural Education 68

    General 68

    Teacher Education 68

    Secondary Vocational Agriculture 71

Guidelines and Strategies for Incorporating Environmental Education into Agricultural Education 73

    General 73

    Agricultural Teacher Education 81

    Vocational Agriculture 83

Suggested Documents and Activities to be Developed at the International Level 86

    General 86

    Teachers and the Vocational Agriculture Programms........... 88

Conclusions 95

Appendices 97

PREFACE

Environmental education is a lifelong education process with the long-term goals (i) to enable humanity to come to terms with the environment, the vastness and limitation of its potentialities and the finiteness of its resources, (ii) to achieve the desired change in the lifestyle and values of individuals and communities towards environmental protection and conservation, and (iii) to enhance the understanding and knowledge that protection and improvement of the environment is indeed the protection and improvement of development for the purpose of uplifting human communities especially in the developing countries to appropriate levels of living. Consequently, environmental education has the objectives of imparting to its target groups, in the context of formal and non-formal education, environmental sensitivity, awareness, knowledge, skills, attitudes, commitments, actions and ethical responsibilities towards the protection and improvement of the environment and its quality, the rational use and management of renewable and non-renewable resources and enhancing environmentally sound and sustainable development.

Unesco's work in the last decade has focused on the incorporation of environmental education into primary and secondary curricula and teacher training, university general education, non-formal education and technical and vocational education through fostering exchange of information, research and experimentation, curriculum and materials development, training of key educational personnel and international cooperation. The development of an environmental education dimension for the curriculum and teacher training for technical and vocational education (industrial, agricultural and commercial schools) is a high priority area because the work of technicians and intermediate-level professionals, blue-collar workers, farmers, business and industrial cadres, craftsmen, etc. - often has a considerable impact on natural resources and, consequently, on the conservation of the productive potential of ecosystems. Currently the environmental education dimension is still only marginally and insufficiently integrated into the curriculum and teacher training for various intermediate technical and vocational specializations in most countries. It is in the context of enhancing the incorporation of environmental education into agriculture education that the preparation of this case study has been undertaken. The case study focuses on environmental education in vocational agriculture curriculum and agriculture teacher education in Michigan, U.S.A. The content of the case study includes the educational system in the U.S.A. and Michigan State followed by curriculum and teacher training in vocational education in agriculture in Michigan. Environmental education major achievements and constraints and guideline for its incorporation into vocational agriculture education form the substantive core of the document. A section is devoted to suggested documents and activities to be developed at international level which is followed by conclusions and appendices.

The case study was prepared at the College of Agriculture and Natural Resources, Michigan State University, U.S.A. Unesco is appreciative of the collaboration of O. Donald Meaders, J. Frank Bobbitt, and David I. Johnson, of Michigan State University, U.S.A., in the preparation of this case study.

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Introduction

The concern worldwide for improving food supplies and reducing poverty has helped bring attention to the role of secondary level programs of agricultural education. Concurrently, the industrialization in many countries with consequent environment degradation and the depletion of natural resources through improper management practices has given agricultural educators a challenge to have vocational education in agricultural contribute to the solution of the environmental problems.

This is a case study of the incorporation of environmental education into both the school curriculum and the teacher education for vocational agriculture in the State of Michigan, U.S.A. The report is organized into eight major parts. First, after the introduction, there is a brief description of the educational system which provides a context for the second part: a description of vocational education in agriculture in Michigan. This is followed by a section on environmental education as integral parts of both the school curriculum for vocational agriculture and the agricultural teacher education program. The subsequent parts are, in order: Major achievements in the incorporation of environmental education in agricultural education; Major constraints in the incorporation of environmental education in agricultural education; Guidelines and strategies for incorporating environmental education into agricultural education; Suggested documents and activities to be developed at the international level; and Conclusions.

This report includes a bibliography of key sources for the readers who want additional information; and a series of annexes (appendices) which provide specific examples to illustrate the incorporation of environmental education in the vocational agriculture curriculum and the teacher education program.

Educational System

The U.S. Educational System

Education in the United States is a responsibility of the individual states. It is governed by policies formulated at federal, state and local levels. The decentralized nature of responsibility for education is evident in the general pattern within most states for local school districts which have locally elected boards. The board members set policies and procedures within the general rules and regulations established by each state. The financing of public education, grades one through twelve is primarily a state responsibility with local districts sharing in the support with state appropriations.

The public education programs are generally described in terms of elementary education, secondary education, and higher education. The meaning of the term elementary education has evolved over the years from referring to grade levels 1-8; to kindergarten through 8; and now many school districts have elementary schools with grades K-5, middle school with grades

6-8, while some have elementary schools with grades K-6. No standard definition for elementary education has been accepted that is appropriate for all school systems.

Secondary education in the public schools includes schools referred to as high schools (grades 9-12), senior high schools (grades 10-12), junior high schools (grades 7-9), and junior-senior high schools (grades 7-12). The comprehensive high school is the most common type of high school.

Higher education in the United States, as defined by the National Center for Statistics, includes study beyond the secondary school level at institutions which offer nondegree programs, associate degrees (two-year), baccalaureate degrees (four-year), or higher graduate or professional degrees. The institutions are commonly named community colleges, junior colleges, colleges, institutes and universities. The decentralized nature of responsibility for higher education has led to much voluntary coordination and has assisted the institutions to be responsive to societal needs.

Programs for preparing teachers in the United States have developed through the cooperative action of discrete agencies and institutions, primarily in response to shifting societal forces, increased level of education of the general population, changing technology and changing teacher certification standards. The standards are set within each state.

Vocational education is an integral part of the public education system. Vocational education is not a single uniform system with identical programs operating throughout the United States. Rather, it is a collection of uniquely different state systems, each responding to the diversity of state and local needs. Although it is a voluntary program, all states and territories have elected to provide vocational education in most high schools and community colleges.

Agricultural education in the public high schools of the United States involves instruction in classrooms, laboratories, and home farms of students, and the work place. Perhaps the unique aspects of vocational agriculture, U.S. style, are (1) the intracurricular supervised occupational experience programs and Future Farmers of America (FFA) organization; (2) the teacher as a community agricultural leader; (3) use of the problem solving approach to teaching and learning; and (4) providing education in agriculture to adults.

The Educational System in Michigan

General

The State Constitution of Michigan vests responsibility for public education in the State Board of Education.

> "Leadership and general supervision over all public education, including adult education and instructional programs in state institutions, except as to institutions of higher education granting baccalaureate degrees, is vested in a State Board of Education. It shall serve as the general planning and coordinating body for all public education, including higher education, and shall advise the Legislature as to the financial requirements in connection therewith."
>
> Article VIII, Section 3, Michigan Constitution, 1963 (1)

The Board is composed of eight elected members who serve eight-year terms. The superintendent of public instruction is appointed by and serves at the pleasure of the Board.

Goals of Elementary and Secondary Education

The State Board of Education provides leadership and supervision for local school programs. However, there is shared responsibility for providing high quality educational programs as illustrated by the following:

> "Education is a shared process. All participants in the educational process -- students, parents, teachers, school administrators, State Legislature, citizens involved in educational decision making, and other social agencies - should carry out responsibilities if Michigan education is to be successful."(2)

The Michigan State Board of Education has adopted fourteen goal areas for student learning and six goal areas for system responsibilities. Two of the learning goals deal with vocational education and one is specific for environmental education. (3)

Of special interest for this study is the 13th goal area for student learning at the elementary and secondary levels. The goal focuses on environment. Specifically, the goal is:

> "13. Acquire the knowledge necessary for the appreciation. maintenance, protection, and improvement of the environment.
>
> a. understand that humans are an inseparable part of a life support system and than whatever they do affects the interrelationships within the system.

b. acquire an understanding of environmental problems and of alternative solutions.

c. become aware of differing environmental value systems and of their potential effects.

d. develop a desire to protect and enhance the environment.

e. develop a personal responsibility to prevent and/or solve environmental problems." (4)

Secondary Education

Secondary education includes instruction in grades seven through twelve and may be carried out through junior high schools (7-9), senior high schools (10-12) and high schools (9-12). The public school enrollment in grades 7-12 in 1981-82 in Michigan was 981,441 or 48 percent of the total enrollment in grades K-12. (5)

Administration:

Each secondary school is administered as part of a local school district which includes grades K-12. The local school district may include several high schools. The school district may have staff specialists such as a curriculum specialist, reading specialist, and science education specialist. (Note: The specialists may serve both elementary and secondary programs).

Organization:

The secondary schools, depending upon the number of students enrolled, may have separate departments such as English, mathematics, science, social studies, and vocational education.

In addition, each secondary school usually has one or more persons for guidance and counseling. Academic and career guidance as well as personal counseling are integral parts of the secondary schools in Michigan.

Vocational education is normally a part of every secondary school. It is generally provided through either the laboratories and classrooms as a part of the regular secondary schools or through area vocational education centers. In either case, it is conducted as a part of the comprehensive school concept. If it is provided an area vocational education center, the students are retain their membership in as student in their home high schools; they take their vocational courses at the center; and they graduate from the home high schools. Each area vocational education center serves several high schools, has its own principal, and offers vocational programs which the home schools are unable to offer due to low enrollment, expensive facilities and equipment, and/or lack of specialized instructors.

Curriculum:

Michigan has a long, accepted tradition of local control over school programs and has few state requirements for graduation. In general, the state requires only three things, related to the curriculum, for high school programs: one semester of Michigan government, at least 180 days of school with 900 hours of instruction, and the use of certificated teachers. (7)

Vocational education is offered as an elective within the context of comprehensive school curricula. Two of the goals for student learning which have been established by the Michigan State Board of Education, relate to vocational education.

> "10. Acquire knowledge about careers, understand the requirements of various career roles, and be able to make career choices. Career is defined here as all of an individual's life roles, e.g. occupational, family, citizen, leisure, and student.
>
> 11. Acquire performance and technical skills related to the content of the chosen vocational program for job entry and continuing education at a high level of competence." (6)

Teacher Certification

Teacher education is offered by both public and private institutions of higher education. The minimum requirement for teaching in Michigan at the elementary or secondary level is the Bachelor's degree including professional education. The State has established minimum standards which are met or exceeded by each institution which recommends graduates for the various teacher certificates.

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1. Michigan State Department of Education, Guidelines and Standards for Quality Vocational Programs in Agricultural/Agribusiness Education in Michigan, (Lansing, Michigan: Michigan State Department of Education, 1979) p. 3.

2. Michigan Department of Education, 1984-85 State Total Reimbursement, (Lansing, Michigan: Michigan Department of Education, 1985), p. 1.

3. Michigan Department of Education, 1985 Follow-Up Survey of 1984 Students, (Lansing, Michigan: Michigan Department of Education, 1985), p. 1.

4. Michigan Department of Education, Guidelines and Standards for Quality Vocational Programs in Agricultural/Agribusiness Education in Michigan, (Lansing, Michigan: Michigan Department of Education, 1979).

5. Daryoush Shahrokh, A Study of the Agricultural Competencies of Senior Vocational Agriculture Students Michigan Based on Their Supervised Occupational Experience Programs, (Ph.D. dissertation, Michigan State University, Department of Agricultural and Extension Education, 1983), pp. 93-100.

6. Frank Bobbitt, An Examination of the Opinions and Supervised Occupational Experience Programs of Selected Vocational Agriculture Instructors in the U.S., (East Lansing, Michigan: Department of Agricultural and Extension Education, Michigan State University), pp. 1-3.

7. Michigan State University, Academic Programs 1985-86, (East Lansing, Michigan: Michigan State University, 1985), pp. 108-109.

Vocational Education in Agriculture in Michigan

Background

Agricultural education in Michigan is primarily oriented toward programs emphasizing vocational agriculture. Vocational agriculture is a program with the primary goal of assisting young men and women to prepare for entry into farming or agribusiness upon completion of the program. Secondary vocational agriculture is a four-year program in most schools and the students enter at the ninth grade level. Emphasis is placed on developing on-the-job work skills as well as leadership skills to complement classroom learning. Each student is expected to participate in the supervised occupational experience component and the Future Farmers of America chapter in addition to participating in classroom activities. All three components have equal emphasis in the program.

Objective

The objective for programs of vocational education in agriculture is presented in the "Guidelines and Standards for Quality Vocational Programs in Agricultural/Agribusiness Education in Michigan" (1).

> "The objective of Agricultural Education is to provide instruction and practical experiences which will prepare students for entry into one or more agricultural occupational areas."

Program Delivery

Occupational groups

The State of Michigan in some cases reimburses local school districts for costs of agricultural education that are in excess of the cost for the normal academic programs in the State. In order to qualify for the "added cost" reimbursement, the State Department of Education has described the types of programs that would be eligible for consideration for reimbursement to include:

1. Production Agriculture/Agribusiness.
2. Ornamental Horticulture.
3. Agricultural Mechanics.
4. Forestry and Natural Resources.

Schools

The delivery of agriculture education is primarily through the comprehensive high school. The comprehensive high schools offers both academic and vocational program. Some area vocational agriculture programs are administered through area education centers. They are relatively a new development in Michigan. Since at some schools there are too few students interested in specialized agriculture education programs at several school districts cooperate to provide the programs to the interested students from the several districts. Each center receives it's students from schools in surrounding districts. It's primary mission is to teach vocational subjects. The students at the center consider their local comprehensive high school as their home school. They take their academic courses at the comprehensive high school and are transported to the area vocational education center for specialized agricultural education.

Level of Schooling

Generally, vocational agriculture is offered for students in secondary education. Students may enter the program at any grade level. The first entry point for comprehensive high schools is usually at the ninth grade. The entry point for the area vocational education centers is generally at the eleventh grade.

The agricultural education program is oriented toward students who plan to enter agricultural occupations as farmers or in some area of agribusiness.

Duration of Schooling

The academic school-year extends from September through mid-June. School is open for 180 days during the academic year. The vocational agriculture program is conducted in classes like the rest of the school. However, students in vocational agriculture are expected to participate in a supervised occupational experience program that often takes place after school, on weekends and/or during the summer. The vocational agriculture program is a 12-month activity for both teacher and student. Most of the growing season is during the summer months thus it is important for students to participate in an experience program that will allow them to maximize their educational opportunities.

Enrollment

According to data from the State Department of Education[2], in 1984-85, there were 213 Vocational Agriculture programs in the State of Michigan with 10,169 students enrolled. The students were enrolled in six kinds of agricultural programs:

	Number Students
1. Agricultural Co-op	146
2. Agricultural Mechanics	530
3. Agricultural Production	8,089
4. Agricultural Products & Processing	9
5. Horticulture	1,241
6. Renewable Natural Resources	154
Totals	10,169

Graduates and Their Employment

The Michigan Department of Education annually conducts a follow-up survey of the previous years graduates[3]. The data in the follow-up study show that students who completed the agriculture educational program in June 1984 were employed in the following manner:

	Number	Percent
[Number] Surveyed	2,139	
Returned	1,605	75.0
Available for work	1,400	87.2
Employed		
Full-time	864	75.9
Part-time	131	11.3
Unemployed	153	9.5
Continuing Education	482	30.0

Curriculum

Federal, State and Local Authority

Funds for the vocational agriculture program are provided from Federal, State and Local governments. However, most of the funds are provided by the local school district (government) which is the agency responsible for curriculum development and implementation. The Federal and State governments participate in curriculum development only in an indirect manner. The Federal and State roles are limited to providing broad guidelines on how funds from their departments of government are to be spent. These guidelines are limited to general statements of program implementation. Local school districts may elect not to accept the funds from these agencies and/or may not be eligible for the funds. As a result, they are free to follow or ignore any specific State or Federal guidelines if they so choose. Since most of the funds come from local school districts, they often choose to establish their own guidelines oriented to the local needs.

Local Curriculum Development

Since no mandated state or national agricultural education curriculum exists, each teacher of vocational agriculture is expected to develop his/her own curriculum oriented to the needs of students in the local community where the program is offered. There are generally accepted procedures that teachers follow to develop their curricula.

Each teacher is encouraged to organize a citizens advisory committee whose primary purpose is to provide advice to the teacher on the appropriateness of various activities for the vocational agriculture program. The citizens advisory committee provides advice on curriculum development, program operation and evaluation of accomplishments. The advisory committee is strictly advisory. Their advice may be directed to the school administrators as well as the teacher.

Often the teacher will prepare a questionnaire or interview instrument that will be used when asking individuals in the local community engaged in agricultural/agribusiness what jobs are available and what skills and knowledge are necessary for students to have in order to enter those jobs.

The teacher utilizes information from the survey results, and other sources such as the U.S. Farm Census, to determine the areas of agriculture that are important in the community.

Teachers use other resources available to them such as books, bulletins, and curriculum guides in addition to their analysis of the local situation to construct a draft of the curriculum. The advisory committee will review the draft curriculum for appropriateness and offer suggestions for change when they feel the curriculum could be strengthened to meet the needs of the local community.

Michigan Department of Education Guidelines[4]

While the State Department of Education has no state curriculum they do play an indirect role in curriculum development by providing guidelines for what constitutes an excellent vocational agriculture program. In addition, the State Department of Education employes consultants in agricultural education who are available to local school districts upon request to provide suggestions on methods of improving the vocational agriculture program.

Michigan Curriculum Guides

The State directly influences the local vocational agriculture program through the production of curriculum guides. The curriculum guides are resources which were produced through a project that employed practicing vocational agriculture teachers to write curriculum materials for some of the key areas of vocational agriculture. Curriculum guides are available in (1) soils, (2) plant science, (3) agricultural mechanics, (4) farm business management, (5) beef, (6) dairy, (7) poultry, (8) sheep, and (9) swine. Each guide includes a list of tasks that are appropriate to carry out when teaching in these areas. Teachers who are constructing curricula may utilize these curriculum guides as one of the resources available to them to get ideas for their local program. Because the guides have been developed by teachers from Michigan, the material is more likely to become a part of a local program than material from other sources.

Advisory Committees

Vocational agriculture is an elective subject. It is a part of the local school only if the people in the district consider it to be more important than other options. It is imperative that the vocational agriculture program meet the real and perceived needs of the local community. To insure that the program is serving the needs of the community vocational agriculture teachers organize citizens advisory committees that meet regularly for the purpose of providing advice to the instructor on the operation of the vocational agriculture programs.

The advisory committee reviews and recommends to teacher and school administrators changes and improvements in the program that would better serve the students and the local agricultural/agribusiness industry. These recommendations are advisory, not policy statements. They can be enacted only upon the approval of the school board, administration and teacher. However, given the responsiveness of the elected school board members and their administrators, these suggestions are taken very seriously and often lead to changes in program.

In addition, the committee is an excellent source of technical information to the teacher. In the modern agricultural/agribusiness enterprise technical advances are so rapid that few teachers can keep up-to-date without systematic contact with farmers and agribusinessmen who are implementing the advances soon after their development. The advisory committee provides the teacher with one opportunity to keep up-to-date on what is taking place in the agricultural and agribusiness industry in their local community.

Structure of the Vocational Education in Agricultive Program

The Vocational Agricultural program is developed within the concept that there are three integrative components necessary for a complete program. Three integrative components are: (1) classroom and laboratory instruction, (2) supervised occupational experience program and (3) the Future Farmers of America curricular club.

Classroom/Laboratory

Classroom and laboratory instruction is based on the problem solving concept. The problem solving method generally involves the following steps.

1. Introduction of a problem area. A problem area is a unit of instruction, generally two to seven days in length, that has been selected by the teacher after an analysis of the needs of students.
2. The teacher works with the class to identify the students problems, questions and concern that they must solve in order to master the knowledge and skills in the area. Typically, the concerns of student arise from problems or experience they are having in their supervised occupational experience program.

3. The teacher, with the help of the class, develops a list of problems, questions and concerns in the order they are to be discussed in class.
4. The first problem is selected to be studied. The teacher then involves the class in discussion to see if the problem can be solved from the past experiences of the students. If it can, the teacher confirms the conclusions of the class and the next problem is selected. If the problem cannot be solved by the class from their collective knowledge the teacher most often resorts to "supervised study." The teacher will have reading material available for students to read in order to solve the problem under discussion. After a brief "supervised study" period the teacher again leads the class in an attempt to solve the problem under discussion.

   The teacher may also elect to use a demonstration, field trips, project work and a variety of other techniques to help students discover the solution to individual problems. The teachers do not lecture to the students. The students under the guidance of the instructor must solve the problem.
5. The students then have the opportunity to apply the learning to their supervised occupational experience programs. The supervised occupational experience program is necessary for the classroom and laboratory

instruction to be effective. Without student supervised occupational experience programs the classroom instruction becomes very academic and not applicable to the real problems of agriculture/agribusiness.

Supervised Occupational Experience

The supervised occupational experience program has three options: (1) the supervised farming program or home project; (2) placement for experience; and (3) the school laboratory. In most programs in Michigan, a mixture of all three options are used by teachers. A recent study in Michigan by Shakrokh[5] reported that students in the 12th grade believed the supervised farming or home project occupational experience program was the most effective of the three options in helping them learn agricultural skills and knowledge. The same study reported the school laboratory was next most effective option followed by the placement for experience option. A national study by Bobbitt[6] found that teachers felt the supervised farming or home project occupational experience was the most effective option, followed by the placement experience option and the school laboratory options. Both studies reinforced the image of supervised occupational experience program, as which utilizes a variety of options to meet the needs of students, an important component in the vocational agriculture program.

The supervised farming (or home) project occupational experience option emphasizes the utilization of projects. Students conduct projects in one or more agricultural enterprise areas, usually at their home. The students are responsible for the management and care of the agricultural enterprise. They keep records on expenses, income and other significant events concerning their projects. The vocational agricultural instructor regularly visits the student at the site of his/her project to check progress and assist the student with any individual problems that may have occurred.

The placement for agricultural experience option is an opportunity for the student to take a part-time job under the supervision of a cooperating employer. The teacher develops training arrangements and activities in which the student will engage during the training period. The teacher, parent, employer and student sign an agreement before the student is placed on the job. The vocational agricultural instructor visits the student often on the job and sees that the provisions of the training agreement are kept by all parties. The visits provide an opportunity for the teacher to see first-hand the problems the students are encountering on the job so they can discuss them during classroom sessions.

The school laboratory is used where both placement and supervised farming are not available. The school laboratory may be a land laboratory, greenhouse or other simulation of work sites in the agricultural/agribusiness industry. Several different configurations are employed. Some teachers rent space to students so they may carry out projects just as if they were on a private farm or business. At other times, the students will work on group projects.

Future Farmers of America

The Future Farmers of America (FFA), the youth leadership organization, is the third component of the Vocational Agriculture program. The club is designed to provide opportunities for students to develop their leadership abilities and to provide incentives for doing a good job with the supervised occupational experience program.

Early in the development of vocational agriculture it was discovered that it was not enough to provide technical information to students in order for them to function most effectively in their communities and on the job. Students needed to be able to express themselves with confidence, understand how to be leaders when the need arose and know how to run an organization in order to get a task completed. The FFA provides the students the opportunity to develop those leadership traits. The organization also provides awards and prizes for achieving certain levels of competence in agriculture as demonstrated through accomplishments in the supervised occupational experience program and the vocational agriculture classroom and laboratory

Programs Areas

Production Agriculture/Agribusiness

The production agriculture/agribusiness program area has the largest enrollment in vocational agriculture in Michigan. The program is concerned with the principles and processes involved in the economic use of facilities, land, water, machinery, chemicals, finance and labor in producing plant and animal products at the farm level.

Ornamental Horticulture

Ornamental horticulture has the second largest enrollment in vocational agriculture. The ornamental horticulture program is concerned with the principles and processes involved in the economic use of facilities, land, water, machinery, chemicals, finance and labor in producing ornamental plants at the home or small business level. In addition, the horticultural program area encompasses greenhouse operation and management, and floriculture.

Agricultural Mechanics

Agricultural mechanics has the third largest enrollment in vocational agriculture. The agricultural mechanics area is concerned with the principles and processes involved in the operation and maintenance of farm power and equipment, either on a farm or in an agricultural equipment sales and service business.

Forestry and Natural Resources

Forestry and natural resources has the smallest enrollment in Michigan vocational agriculture. The emphasis area is relatively small but it represents an important component in the program. The forestry and natural resources area is concerned with the principles and processes related to skills in forestry and related industries.

Teacher Education

All regular teachers of vocational agriculture must complete a teacher education program. The agricultural teacher education program for Michigan is a bachelor's degree program in the College of Agriculture and Natural Resources at Michigan State University. The name of the major is Agribusiness and Natural Resources Education[7]. The title "Agribusiness and Natural Resources Education" was chosen to communicate the breath of the program. Teachers completing the program may be recommended for certification in one or more of four program areas including: (1) production agriculture; (2) ornamental horticulture; (3) agriculture mechanics and (4) agribusiness. Students in Agribusiness and Natural Resources Education are regular students of Michigan State University and must complete the degree requirements of (1) the university; (2) College of. Agricultural and Natural Resources; and (3) the Department of Agricultural and Extension Education. In addition, to be certificated in the State of Michigan, they must complete an approved minor in another teaching area. All graduates of Michigan State University must complete 180 quarter credits* with a GPA of 2.0 or better in order to be awarded their B.S. degree.

General University Requirements

The University requires that all baccalaureate graduates complete 45 quarter credits in general studies. For students in Agribusiness Education, these include 9 credits in American Thought and Language, 12 credits in Social Studies, and 12 credits in Humanities. The required credits in Natural Science are waived for College of Agriculture students. These courses provide the students with a firm base in general studies and are usually completed during the first two years of study at the University.

College of Agriculture and Natural Resources Requirements

The College of Agriculture and Natural Resources requires 11 credits in Chemistry, 10 credits in Mathematics, 5 credits in Biology, 6 credits in writing or speaking, 4 credits in Economics, and 40 additional credits from departments in the college. The Agribusiness and Natural Resources Education students must take at least 54 credits in the College of Agriculture and Natural Resources. These must include at least one course from Animal Science, Plant and Soil Science, Agricultural Engineering, Agricultural Economics, Horticulture and three courses from the departments in Natural Resources.

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*Michigan State University operates four terms each year. A full academic year is 3 terms (quarters) including Fall, Winter, and Spring. Each term is ten weeks long.

Education Requirements

The University, in compliance with the requirements of the Michigan State Department of Education requires completion of 35 credits of professional education course work in order to be recommended for the initial teaching certificate. The courses include Educational Psychology (5 credits); Educational Philosophy (5 credits); General Methods (2 credits); Agricultural Teaching Methods (3 credits); student teaching experience (15 credits); and Methods of Teaching Reading (5 credits). Students must complete their student teaching experience under the direction of a qualified vocational agriculture teacher.

Minor Requirements

The State of Michigan requires that all teachers must have both a teaching major and a teaching minor. A specific minor requires 30 credits; a group minor requires 36 credits. While all minors are available to Agribusiness and Natural Resources Education students, most choose from two minors that have been especially designed for persons preparing to teach vocational agriculture. The minor most often chosen is Applied Science which requires 36 credits with courses in mathematics, chemistry, biology, and physics.

The other minor frequently taken is Biological Science which requires 36 credits from the biological sciences and includes courses from the areas of animal science (Principles of Animal Nutrition), crops and soil science (Genetics of Plants and Animals), botany, biological science, and entomology.

Another minor selected by some of the students is the Natural Resources Environmental Education minor which requires 36 credits to complete. Students electing this minor must complete courses in the areas of fisheries and wildlife, forestry and natural resources, horticulture and crop sciences, park and recreation resources, and resource development and public affairs management.

In-service Program

The Department of Agricultural and Extension Education at Michigan State University provides an extensive in-service education program. The in-service program is conducted both on a credit and a non-credit basis. The in-service program with college credit includes graduate programs leading to the M.S. and Ph.D. degrees plus continuing certification programs. All graduate programs include a mix of general professional education, agricultural education and technical education in agriculture.

The non-credit in-service education program includes a series of workshops and seminars arranged by the Michigan State University agricultural teacher education staff in consultation with the State Department of Education and teacher representatives from the Vocational Agriculture teacher's professional organization (Michigan Association of Teachers of Vocational Agriculture). An example of one-inservice program is the summer technical agriculture workshop, which is a weeklong program for teachers to update their skills in both technical and professional areas.

The agricultural teacher education staff also offers an in-service program on both a credit and a non-credit basis for beginning teachers. All beginning teachers are by professors of agricultural education from Michigan State University visited in their schools in an effort to assist them to successfully adjust to teaching during their first year. In addition, there is a course that is offered for graduate credit that combines a series of seminars and staff visits to help the teacher succeed in teaching.

Environmental Education

Environmental education has been incorporated into the vocational agriculture programs at the local level and into some parts of the agricultural teacher education program. The emphasis and incentives have come mainly from the context of the local programs and the technical components of the agricultural teacher education program.

In Vocational Agriculture

Environmental education in agriculture is, for the most part, not a separate program area. Environmental education is an important part of the vocational agriculture curriculum. However, environmental education will be found as an integral part, or a sub-part, of problem areas which make up the course of study in vocational agriculture.

Objectives

The curriculum guides that Michigan teachers use to develop their local curricula do not use the term "objectives." Rather, the guides use the term "tasks." The term "task" is utilized in order to promote the use of competency based education procedures. Tasks are a series of learning activities that must be mastered if the student is to become competent in a particular area.

Crops

The curriculum guide entitled "Crops"[1] lists 92 tasks that the developers believe students should master in order to be competent in the areas of crops. Specific tasks related to environmental education include:

1. Control crop diseases using appropriate information to insure healthy crops.
2. Control weeds using appropriate information to provide for increased crop growth.
3. Control insects using appropriate information to eliminate insect problems.
4. Store and dispose of unused farm chemicals using appropriated knowledge to provide a safe environment.
5. Treat grain using gas type insecticide to kill insects.
6. Treat grain using liquid type insecticide to kill insects.
7. Treat grain using solid (powder) type insecticide to kill insects.

Soils

The curriculum guide entitled "Soils"[2] contains 44 tasks. The tasks related to environmental education include:

1. Apply fertilizer/lime using appropriate tools and equipment to obtain proper amount and placement.
2. Use green manure using appropriate crops to improve soil conditions.
3. Chop weeds and crop residue using rotary mower, chopper or tillage equipment to facilitate weed control and tillage operation.
4. Apply animal manure using solid or liquid spreader to obtain proper amount and placement.
5. Lay out contour using survey equipment and stakes to minimize erosion.
6. Construct a terrace using survey equipment and appropriate tools and equipment to minimize erosion.
7. Make a sod waterway using survey equipment and appropriate tools and equipment to maximize drainage and minimize erosion.
8. Reduce wind erosion using shelter belts, windbreaks and tillage to reduce loss of topsoil.
9. Analyze a field using appropriate tools and equipment to determine drainage requirements.
10. Subsoil land using subsoiler to break-up a hardpan for good water and root penetration.

11. Reduce erosion using conservation tillage to maintain longterm productivity.
12. Till soil using tandem or offset disc harrow to prepare seedbed and eliminate weeds.
13. Till soil using a disc plow to bury trash and bring up moist soil for desirable seedbed and to prevent disease.
14. Till soil using a moldboard plow to bury trash and bring up moist soil for a desirable seedbed and to prevent disease.
15. Till soil using a chisel plow to break-up hard compacted soil for less erosion and to aerate soil.
16. Determine land capability classification and most intensive safe use.
17. Recommend management and conservation practices.
18. Determine suitability of land for non-agricultural uses.

Farm Mechanics 3

The curriculum guide entitled "Farm Mechanics" contains 251 tasks. The tasks related to environmental education include:

1. Mount slow-moving vehicle emblems on farm machinery to insure safe road travel.
2. Replace warning signal or implement lights to restore safe road and lighting conditions.
3. Replace flasher light blubs to maintain safe road operation.
4. Replace flasher unit to restore safe road operation.
5. Replace headlights to restore adequate lighting.
6. Replace taillights to restore proper lighting.
7. Adjust headlights to assure lighting.
8. Remove and replace defective machinery guards and shields to restore adequate protection.
9. Clean small engine repair shop to restore clean, safe conditions.
10. Install circuit breakers in panel to provide safe operation.
11. Replace circuit breakers to insure safe electrical system.
12. Repair or replace frayed service cords to insure safe electrical system.
13. Install/connect power failure lighting to provide safety (back-up) lighting.

Farm Business Management

The curriculum guide entitled "Farm Business Management"[4] contains 126 tasks. The tasks related to environmental education include:

1. Enroll in Agricultural Stabilization Conservation Service (ASCA) to utilize available services.
2. Enroll in Soil Conservation Service (SCS) to utilize available practices.
3. Develop plan for pesticide need to control problem pests.
4. Make inspections for safety hazards to reduce accidents.
5. Establish pollution controls to improve the environment.
6. Develop energy saving programs to reduce energy consumption.

Beef[5]

The curriculum guide entitled "Livestock: Beef" contains 136 tasks. Tasks related to environmental education include:

1. Remove afterbirth, using sanitary methods, to secure a healthy cow.
2. Dispose of unused chemicals and drugs, using appropriate equipment, to ensure a healthy environment for the herd.
3. Store chemicals, inflammable materials and medications, using appropriate resources and instructions, to insure safe environment.
4. Care for animal feed, using appropriate equipment to maintain healthy animals.
5. Select feeding methods, using appropriate resources, to provide for maximum cost effectiveness and performance of animals with minimum feed wastage.
6. Examine feedstuffs for mold and spoilage, using appropriate techniques and equipment, to identify hot areas, sprouted grains and off color.
7. Examine beef for external parasites, using appropriate resources, to determine suspect cattle.
8. Apply insecticides in buildings, using appropriate equipment, to maintain herd health.
9. Dust cattle, using appropriate resources, to maintain her health.
10. Spray cattle, using appropriate resources to maintain her health.

11. Examine beef for internal parasites, using visual appraisal, to determine suspect cattle.
12. De-worm with paste/bolus, using appropriate methods, to ensure herd health.
13. Drench cattle, using appropriate resources, to maintain herd health.
14. Treat cattle for internal parasites, using appropriate resources to ensure a healthy beef herd.
15. Plan a general health program to ensure a healthy beef herd.
16. Treat cattle for contagious diseases, using appropriate resources, to ensure herd health by limiting contamination.
17. Vaccinate calves for black leg, using appropriate resources, to ensure healthy calves.
18. Vaccinate calves for leptospirosis and anaplasmosis, using appropriate resources and recommendation, to ensure herd health.
19. Vaccinate heifers for Brucellosis (Bang's Disease), using appropriate resources and regulations, to ensure herd health.
20. Dehorn animals, using appropriate resources, to ensure the horns are removed and hemorrhaging is controlled, to assure safety of handlers and other animals.
21. Isolate newly purchased animals, using appropriate resources and methods, to ensure herd health.
22. Dispose of dead animals, using appropriate resources, to avoid contamination of water or feed supply and prevent access to carcass by livestock or predators.
23. Disinfect building and equipment, using appropriate resources, to ensure a sanitary environment.
24. Clean housing, using appropriate resources to ensure a sanitary environment.
25. Construct back-scratcher for insecticide application, using appropriate tools and equipment, to apply desireable amount of insecticide.
26. Plan waste disposal system, using appropriate resources, to assure an efficient, cost-effective system that meets local/state/federal pollution standards.
27. Remove wastes, using appropriate resources, to maintain a clean beef yard within local/state/federal pollution standards.
28. Apply wastes to fields, using appropriate equipment, to assure an efficient, cost-effective and pollution-free method.

Swine

The curriculum guide entitled "Swine"[6] contains 120 tasks. The tasks that relate to environmental education include:

1. Remove manure from quarters and pens, using appropriate equipment, to maintain proper health and sanitation.
2. Dispose of unused chemicals and drugs, using appropriate resources, to assure safety on the farm.
3. Store chemicals, inflammable materials and medications, using appropriate resources, to assure safety on the farm.
4. Clean swine pens and housing, using appropriate resources, to assure proper sanitation.
5. Disinfect buildings and equipment, using appropriate resources, to assure proper sanitation.
6. Apply insecticides in buildings, using appropriate resources, to assure proper herd health.
7. Disinfect boots and clothing, using appropriate resources, to assure proper herd health.
8. Plan a parasite control program, using appropriate resources, to assure proper herd health.
9. Dust swine, using appropriate resources, to assure proper herd health.
10. Spray swine, using appropriate resources, to assure proper herd health.
11. Worm hogs, using appropriate resources, to assure proper herd health.
12. Plan a disease control program, using appropriate resources, to assure proper herd health.
13. Treat hogs for contagious diseases, using appropriate resources, to assure proper herd health.
14. Detusk boars, using appropriate equipment, to prevent injury to sow herd and farmer.
15. Isolate newly purchased animals for observation, using appropriate resources, to maintain proper herd health.
16. Separate sick, weak or injured animals, using appropriate resources, to help maintain proper herd health.
17. Dispose of dead animals, using appropriate resources, to maintain a proper health herd program.
18. Remove wastes, using appropriate equipment, to provide proper health and sanitation.
19. Apply wastes to fields, using appropriate equipment, to dispose of wastes in an efficient cost-effective and pollution-free manner.

Sheep

The curriculum guide entitled "Sheep"[7] contains 139 tasks. The tasks related to environmental education include:

1. Dispose of unused chemicals and drugs, using appropriate resources, to ensure safety of humans and animals.
2. Store chemicals, inflammable materials and medications, using appropriate resources, to ensure health and safety of humans and animals.
3. Dip sheep, using appropriate equipment, to ensure the health of the sheep.
4. Dust sheep, using appropriate equipment, to control external parasites.
5. Spray sheep, using appropriate equipment, to control external parasites.
6. Worm sheep using drenching method, using appropriate resources, to remove internal parasite.
7. Worm sheep using pill/bolus method, using appropriate resources, to remove internal parasites.
8. Develop pasture rotation schedule, using appropriate resources, to provide an adequate health program on pasture.
9. Plan a disease control program, using appropriate resources, to ensure flock health.
10. Administer medication by injection, using proper equipment, to ensure health of the sheep.
11. Administer oral medication, using approved equipment, to ensure health of the sheep.
12. Treat sheep for contagious diseases, using appropriate equipment, to ensure flock health.
13. Isolate newly purchased animals for observation, using approved resources, to ensure the health of the flock.
14. Separate sick, weak or injured animals, using appropriate equipment, to ensure the health of the flock health.
15. Dispose of dead animals, using appropriate resources, to maintain a proper flock health.
16. Apply insecticides in building, using appropriate resources, to maintain flock health.
17. Disinfect buildings and equipment, using appropriate resources, to maintain flock health.
18. Clean sheep pens and housing, using appropriate resources, to maintain flock health.
19. Apply wastes to fields, using proper procedures and techniques, to ensure public health and adequate waste disposal.
20. Build foot bath, using appropriate resources, to adequately treat farm flocks and increase labor efficiency.

21. Inspect buildings, using proper procedures and resources, to ensure general health and safety.

Poultry

The curriculum guide entitled "Poultry"[8] contains 69 tasks. The tasks related to environmental education include:

1. Control rodents, using appropriate resources. to maintain clean environment.
2. Dispose of unused chemicals and drugs, using appropriate procedures, to insure safe environment.
3. Store chemicals, inflammable materials and medications, using appropriate equipment, to maintain a safe environment.
4. Clean walls, screens, ceiling, and equipment, using appropriate practices, to acquire desirable production environment.
5. Disinfect building and equipment, using appropriate practices, to acquire desirable production environment.
6. Keep birds free of ectoparasites (mites and lice), using appropriate resources, to achieve desirable production environment.
7. Keep poultry houses and premises free of house flies, using appropriate resources, to achieve desired production environment.
8. Administer medications, using appropriate procedures, to achieve desirable health standards.
9. Clean medicator, using appropriate procedures, to maintain disease control.
10. Take sick bird(s) to poultry disease diagnostic laboratory for diagnosis, using appropriate means, to prevent increase in flock mortality.
11. Separate sick, weak, or injured birds, using appropriate procedures, to prevent health problems.
12. Dispose of dead birds, using appropriate procedures, to maintain proper health standards.
13. Apply insecticides in buildings, using appropriate procedures, to maintain health standards.
14. Disinfect buildings and equipment, using appropriate procedures, to maintain proper health standards.
15. Clean poultry housing area, using appropriate procedures, to maintain proper health standards.
16. Adjust feeders and waterers, using appropriate resources, to limit feed on water waste.
17. Clean feed bins, using appropriate procedures, to maintain proper health environment.
18. Adjust ventilation system, using appropriate resources, to insure quality health environment.
19. Clean air inlets, using appropriate resources, to insure quality health environment.

20. Apply wastes to fields, using appropriate resources, to insure proper waste disposal.
21. Plan waste disposal system, using appropriate resources, to insure proper health environment.
22. Remove wastes, using appropriate resources, to insure healthy disease tree growth environment.

Dairy

The curriculum guide entitled "Dairy" contains 98 tasks.

The tasks that relate to environmental education include:

1. Dispose of unused chemicals and drugs, using appropriate resources, to assure us of high quality chemicals and drugs.
2. Store medicines and chemicals, using appropriate resources, to maintain quality and to ensure safe use.
3. Disinfect buildings, using appropriate resources, to conform with milk market standards for sanitation.
4. Applied insecticides in buildings, using appropriate resources, to minimize infection by insects to dairy animals or products.
5. Control parasites (external/internal) and external infection, using appropriate resources, to insure proper health and productive and reproductive efficiency.
6. Administer medication, using appropriate resources, to adhere to specifications on container labels and assure proper health both for animal and human consumption.
7. Vaccinate animals, using appropriate resources, to effectively administer needed medication for proper health.
8. Dehorn animals, using appropriate resources, to assure safety of handlers and other animals.
9. Isolate newly purchased animals for observation, using appropriate resources, to assure that no diseases or infections are brought into the herd.
10. Separate sick, weak or injured animals, using appropriate resources to eliminate competition for food and water and to provide individual attention.
11. Dispose of dead animals, using appropriate resources, to meet local environmental and health standards.
12. Clean freshening pans and calving facilities, using appropriate resources, to maintain proper sanitary conditions for herd health.
13. Dust or spray dairy cattle, using appropriate resources, to provide for pest free conditions for dairy cattle.
14. Apply wastes to fields, using appropriate resources, to insure that wastes are transported and applied in an efficient, cost-effective and pollution-free manner.

15. Remove wastes, using appropriate resources, to insure that wastes are removed and handled accoridng to local, state and federal standards for ground water and air pollution.
16. Construct feed trough, using appropriate resources, to provide a well-braced trough free from sharp corners that will reduce feed waste.
17. Construct back-scratcher for insecticide application, using appropriate resources, to insure minimum problems from insects.
18. Plan waste disposal system, using appropriate resources, to provide a system that is efficient, cost-effective and capable of handling all animal waste material.
19. Maintain milking system, using appropriate resources, to maintain specified sanitary conditions.
20. Clean the milking system, using appropriate resources, to maintain a bacterial count within limits of prevailing market/milk plant standard.
21. Clean milking parlor, using appropriate resources, to maintain proper sanitary conditions.

Knowledge

The knowledge obtained through a vocational agriculture program is oriented toward the application of principles in a practical situation. The environmental education taught in an agricultural class is most often integrated into the production unit under study.

Environmental education is included in production units for a number of reasons. First, there is a genuine concern on the part of the public that the problems of the environment be a part of public education. Secondly, attention to environmental problems is sound managerial policy. Finally, Federal and State governments have enacted numerous laws and regulations to which producers must adhere. Teachers take these three factors into consideration when constructing their curricula so that there is a proper balance of concern for the environment and efficiency factors.

Instructional Methods

The same instructional method for teaching environmental education is followed as for any other topic in the vocational agriculture curriculum. The problem solving method of teaching is the predominate teaching technique.

This means that the teacher must help the students to see the importance of protecting the environment in which the agricultural industry operates. Just as students will list their problems, questions and concerns in a problem area in order to understand how to run an effective and efficient agricultural enterprise, the teacher leads the students to identifying environmental problems, questions and concerns when solving an agricultural problem area.

After the problems, questions and concerns are identified, the teacher leads the students through the process of solving the problem. The teacher either confirms or questions the student's solution. If the student's solution was not correct they try again until they arrive at the correct solution to the problem. The solution to the problems that students are expected to enact, where possible, in their supervised occupational experience program include approved practices related to maintaining and/or improving the environment.

Evaluation Process

Students are evaluated on their level of mastery in two major ways. They take the usual quizzes and tests in class and laboratory. In addition, the teacher visits each student at the site of his/her supervised occupational experience program to evaluate the level of implementation of the concepts and principles in an actual work situation.

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1. Michigan State University Curriculum Resource Team, Agriculture: Crops, (East Lansing, Michigan: Agricultural and Extension Education, Michigan State University, 1983), pp. 1-6.
2. Michigan State University Curriculum Resource Team, Agriculture: Soils, (East Lansing, Michigan: Agricultural and Extension Education, Michigan State University, 1983), pp. 1-3.
3. Michigan State University Curriculum Resource Team, Agriculture: Farm Mechanics, (East Lansing, Michigan, Agricultural and Extension Education, Michigan State University, 1983) pp. 1-14.
4. Michigan State University Curriculum Resource Team, Agriculture: Farm Business Management, (East Lansing, Michigan: Agricultural and Extension Education, Michigan State University, 1983), pp. 1-7.
5. Michigan State University Curriculum Resource Team, Livestock: Beef (East Lansing, Michigan: Department of Agricultural and Extension Education, College of Agriculture and Natural Resources, Michigan State University, 1984) pp. 9-16.
6. Michigan State University Curriculum Resource Team, Livestock: Swine (East Lansing, Michigan: Department of Agricultural and Extension Education, College of Agriculture and Natural Resources, Michigan State University, 1984), pp. 9-15.

7. Michigan State University Curriculum Resource Team, Livestock: Sheep (East Lansing, Michigan: Department of Agricultural and Extension Education, College of Agriculture and Natural Resources, Michigan State University, 1984), pp. 9-16.

8. Michigan State University Curriculum Resource Team, Livestock: Poultry, (East Lansing, Michigan: Department of Agricultural and Extension Education, College of Agriculture and Natural Resources, Michigan State University, 1984), pp. 9-13.

9. Michigan State University Curriculum Resource Team, Livestock: Dairy, (East Lansing, Michigan: Department of Agricultural and Extension Education, College of Agriculture and Natural Resources, Michigan State University, 1984), pp. 9-13a.

In Agricultural Teacher Education

The agricultural teacher education program at Michigan State University contains significant amounts of emphasis on environmental education. Most of that emphasis is provided through specific courses focused on the environment and as integral parts of other courses--general, technical, and professional education.

Objectives

There are two broad objectives for the agricultural teacher education program. The first objective is to prepare the persons to have the necessary competencies to suceed at the beginning teacher level. The beginning teachers are expected to incorporate into their teaching plans the concepts and practices, related to appreciation, maintenance, protection and improvement of the environment.

The second objective is to help the students make a successful beginning on their personal careers. Although a majority of the gradutes enter into teaching vocational agriculture, others may have opportunities to work as professionals in extension, government and the private sector. Some may return to farms. The agricultural education program is designed to develop their leadership skills as well as their technical competencies for helping to conserve the natural resources and to protect and improve the environment as a part of their career.

Knowledge

The knowledge development, as a part of the curriculum for agricultural teacher education, is contained in the courses from various departments and colleges. The courses for the required general education credits in the social sciences provide the students with broad understandings about societal values and environmental issues. This may be illustrated by the titles of some of the courses from which the students may select to complete the social science requirement.[1] They are, namely:

"Americans and their values"
"Coping with changing institutions in modern society."
"World urbanization: cultures and common issues."
"War and morality"
"Human values and politics: On liberty"

Professional Education

Only some of the 35 credits in professional education contain concepts directly related to environmental education. The outlines for the courses in educational psychology (5 credits), educational philosophy (5 credits), general methods of teaching (2 credits) and methods of teaching reading (5 credits) contain no direct references to the planned teaching of concepts related to the environment. However, the other 18 credits, represented by methods of teaching agriculture (3 credits) and practice teaching (15 credits) do include directed instruction and practice which help the students learn how to integrate concepts of environmental education into their teaching. This is accomplished through practice in preparing lesson plans, micro-teaching, and during practice teaching (10 weeks at a high school with an outstanding vocational agriculture program).

Technical Education

The environmental education contribution to agricultural education undergraduate students is concentrated into primarily four courses. Many other courses are available for students to take from the four natural resources departments: Fisheries and Wildlife, Forestry, Park and Recreation Resources, and Resource Development. Each of these departments has courses that contribute to the goals that are environmental education oriented. A list of those courses that might contribute to environmental education understanding for agricultural education students is included in the Natural Resources and Environmental Education curriculum which is included in the appendices of this document. (Appendix A)

In addition to courses that are available to agricultural education students, they may elect a minor field entitled Natural Resources and Environmental Education (NREE). The minor in NREE is a 36-term credit hour adaptation of the 54 term credit hour major available to Michigan State University students. The requirements for the NREE minor are also listed in the appendices (See Appendix A). It should be reiterated here that most agricultural education students take one of the two specialized science minors designed particularly for combination with their major.

However, most agricultural education students take primarily four courses in Natural Resources with an environmental emphasis. Of these four, two of them are used most frequently. These two are Fisheries and Wildlife 203, "Resource Ecology" and Resource Development 301, "Conservation of Natural Resources."

FW 203 has the largest of enrollment of the two courses with a long history within the university, having served thousands of students since its initiation in 1968. In the early seventies, at the peak of the latest conservation/environmental movement, the course was offered in two sections. Class sizes began to decrease along in the late 70's along with enrollment in many other environmentally focused courses.

Use of television for teaching. To aid in stemming this erosion of student credit hours (the course contributes about 50% of the Department of Fisheries and Wildlife annual credit hours), the course was adapted to a television format to make the course more convenient to atypical students and to allow use of the variety of video-materials that would be case studies or examples of current environmental issues. In this format, the course is offered as a live section to 90 students and as many as two other sections that are viewed from television monitors on the same day on the university campus. In addition, the class is available off-campus via cable TV the same day as the live class. On Sunday mornings, all three classes for the week are re-played on cable in a three hour sequence. And lastly, all classes are available on videotape for students to view at the Michigan State University Library during library hours. Television does offer virtually unlimited opportunity for students to obtain the course content.

Using television as a format also creates some limitations that were not anticipated by the instructor of the course. Some students just prefer the live class and as a result will not enroll in a TV section or will enroll in the TV section and then attend the live section. The more difficult problem is the unavailability of copy-righted materials for showing off-campus without purchasing the rights at rather high cost. In order to use these materials without purchase it is necessary for students who normally view via the off-campus showing, to come to the library for viewing the copy-righted material. Using the television format reaches about 600 students each academic year.

FW 203, Resource Ecology. The content of FW 203, "Resource Ecology" parallels the content of most environmental science type courses at the university/college level. It is supported by the availability of textbooks with the appropriate type of content. (See Appendix B) The textbooks can provide examples, diagrams, differing viewpoints, and literature that can enhance the overall perspective of the student. The goals of the course are:

1. To create an ecological background for students to evaluate and understand environmental problems.
2. To examine current environmental problems with special emphasis on the roots and long-term consequences.

3. To recommend short- and long-term solutions for the problems discussed.

To accomplish goal one, the approach is primarily lecture on some general topic areas proceeding from the individual organism to ultimately the biosphere as a whole. For the individual organism the concepts of limiting factors and tolerance ranges are exemplified for a variety of environmental conditions such as temperature, water availability, dissolved oxygen in water pH, and many other conditions. From this the indicator species as a measure of the quality of a particular system are presented. Synergistic interactions, both positive and negative in the context of environmental conditions, are discussed. Lastly, tolerance ranges are illustrated with toxicity ranges incuding the terminology, testing process, organisms used, and commonly used criteria. This is followed by a brief discussion of risk, and its use in decision-making.

The discussion of limiting factors is followed with the study of population dynamics. Under this general topic, students study such issues as growth rates, biotic potential, carrying capacity, life tables, death rates, immigration, emigration, generation time, grow curve shapes, and population management. Both plant and animal populations are discussed in the context of these topics. These same topics are then applied to human populations with special emphasis on fertility rates, demographic transition, birth rate/death rate changes, age diagrams, and marriage age in relation to teen pregnancy. This material is followed by NOVA, a public television video tape ("China's Only Child"), presentation on the population control policies of China.

The second major topic under goal one is community interactions between multiple populations. The conceptual emphasis under this topic is succession or community change. Students are helped to understand terms like sere, seral stage, and climax community as various stages in the community development process. Also included are implications of ecosystem development on other resources such as soil, climate, species diversity, and land use potential. Finally, application is made as to the need to balance productive, protective, and multiple use systems to maintain ecosystem integrity.

Still working on goal one, the course focus changes to major functional relationships in energy flow and biogeochemical cycles. Energy flow topics are proceeded with a general presentation on the four laws of thermodynamics. In ecosystem energy flow, the topics included are food chains, food webs, loss during energy transfer, measures of productivity, energy pyramids, and energy flow diagrams. Implications are then discussed for human food chains, endangered species, long term fossil fuel use, agricultural systems, loss of productive environments, and biomagnification of chemicals.

The next major topic is biogeochemical cycles. Understanding how materials move in the biosphere is important to understanding major world environmental issues such as acid rain, hazardous waste, solid waste, water pollution, and the use of water for agricultural and manufacturing needs. Since the water cycle is commonly understood by most students, we begin with that discussion emphasizing distribution, flow, and storage aspects as applied to human use. A similar approach is taken for the carbon dioxide cycle; however the focus is on fossil fuels, acid rain, and atmospheric changes. With this background, a general biogeochemical cycle is presented to complete conceptualization. An in-depth look is taken at the nitrogen and the phosphorus cycles as important agricultural nutrients and as illustrations of biologically controlled gaseous cycles and geologically controlled cycles. Global and human impact is discussed.

The environmental problems discussed during the three successive terms of the academic year tend to change as different problems are prominent in the media. Current topics that are being discussed are as follows:

- Human population
- Acid Rain
- Toxic materials
- Hazardous waste
- Solid waste
- Great Lakes resource management
- World food production
- Lake eutrophication
- Endangered species
- Desertification
- Kepone case study
- Nuclear power

The intent in each of these presentations/discussions is to describe the fundamental facts of the situations; relate the divergent points of view that are taken by opposing groups; provide a political and regulatory background for the topic; and lastly, consider alternative solutions as we attempt to accomplish goal three for the course. During these discussions, much reference is made toward the ecological conceptual framework that is applicable to each situation. Several guest lecturers are used in this course to tap the vast expertize available at Michigan State University and to illustrate the diversity of people who are working on each of these issues. Two videotape field trips (a local sewage treatment plant and a local power plant) are also presented during the term.

Other methods and topics are used to achieve the goals. Early in the term, a world model is presented and the students are asked to describe the components and the dynamics of the model and to relate how those changes apply to different types of environmental problems. This approach gives the student exposure to systems thinking and a concise, easily graded written assignment.

A second writing assignment is used to develop data interpretation skills. Population data from four different countries in four different stages of demographic transition (I-IV) are given to the students with instructions as to the objectives of the paper. In general, students are asked to calculate growth rates and doubling times for the four cases. And with population age structure data, the students are asked to calculate dependency ratios for the four cases. The students are then asked to, in written form on one-page, differentiate between the four populations using the parameters provided and their calculations. And then to identify current examples of countries that are similar to these four demographic transition categories.

These two short written papers constitute about 40% of the evaluation of the students in the class over the course of the term. Two other exams in the traditional multiple choice true/false format are used at the mid-term and for the final exam. The exams are structured to sample the vast content of the course and the final is comprehensive. Questions are designed to test not only recall, but also comprehension, evaluation, calculation, and integration.

It should be reiterated here that this course is a general university course taken by a diversity of majors within the university ranging from social science to elementary education. On the Student Instructional Rating System the course is highly praised as a course that should be required for all students at the university. Agricultural education students generally express a greater interest in the problem orientation then in the conceptual ecological framework. However, it appears that most have never been exposed previously to the ecological ideas of the course.

RD 301, Conservation of Natural Resources. This course, offered by the Resource Development Department, is the oldest of the natural resources courses that are not part of a traditional zoology, botany, biology curriculum. It was initiated in the university in 1938 as the result of demand of what is termed the second wave of conservation in the United States. The first wave was the call for conservation, particularly of forest resources, in the early part of the twentieth century. The second wave came in the 1930's in the wake of the dust bowl storms of the prairies which caused a public outcry and a legislative response for federal soil conservation programs to protect soil during those difficult economic times for farmers. Under those social conditions, educational institutions responded by offering instructional programs to deal with the popular issues. Surprisingly, this course is a survivor from that earlier era of conservation.

The course emphasis has changed with instructors over the years. At its beginning the course focused on knowledge regarding the major natural resources including soil, water, forests, minerals, and wildlife. Instructional methods provided facts on consumption, descriptions of the quantity of resources available, and some techniques to maximize longevity of use. When a new instructor took over the teaching, there was a shift in emphasis to federal programs that dealt with each of the resources. Another change of instructors again occurred in the 1950's. With this change, the focus became specifically Michigan natural resources and a resulting decrease in the national focus.

The last major change content occurred in 1961 with a change of instructor. This instructor brought to the course a social science, economic perspective. The course syllabus identifies a three-fold framework for the course. The first aspect is the physical/biological characteristic of the resource independent of human use. This section describes the quantity, quality, and location of the resources. Economics is the second part of the framework. Price often determines the quantity and quality of resources available because higher prices encourage the use of different technologies. As technology changes the type of resources in demand may also change as the result of price differential or product quality. Market demand as part of the economic system may also modify consumption of resources. The third aspect for emphasis in the course is the institutional context for resource utilization. This includes the legal structure, the tax incentives or disincentives, the type of industry, the consumptive characteristics of the society, and the value/belief systems of the society.

Given this context, the course examines the following list of resources:

mineral
energy
land use
cropland
forest
recreational land use
urban land use
wildlife
fisheries
oceans
water quality
water rights
food production

The complete list of course topics is available in the appendices. (See Appendix C)

The format used to communicate the course content is primarily lecture/discussion format. Evaluation of the course is via a mid-term and final exam weighted 40% and 60%

respectively. The examinations are in a multiple choice format. Sample questions can be found in the appendices.

This course has an enrollment of 40-60 students per term of which 10% may be agricultural education students. In this course, agricultural education students have an opportunity to interact with a variety of students from other majors, some related but most unrelated to natural resource majors.

FW 484, Outdoor Environmental Education. Still fewer agricultural education students take Fisheries and Wildlife 484. It is offered only one term per year with an attendance of twenty or less per term. During any one term, five percent of the class might be anticipated to be agricultural education students. This course is the first of two courses that were created to provide for students majoring in Natural Resource and Environmental Education (NREE), a methodological core. The original intent of the course was to provide NREE students with the ability to identify natural organisms in the out-of-doors so that these pre-service teachers were especially comfortable in using the outside classroom for instructional activities. In its original design, the course emphasized the identification process, the collection process, the recognition process, and the interpretive process for local plant and animal species. However, in 1978, a person with specific training in environmental education was hired and under his influence, the course has become more of an entry level environmental education methods course.

The five goals of the course are as follows:

I. To present a frame of reference for Environmental Education/Outdoor Education (EE/OE) including philosophies and goals, to guide teachers in curriculum development, evaluation, and implementation.

II. To acquaint teachers with some major principles of learning theory and their applications for EE.

III. To acquaint teachers with the variables impinging on the formation of environmental value and belief systems and attitudes, the roles of these in determining eventual problem solving behavior, and the role of education in natural resources decision-making.

IV. To acquaint teachers with OE methods and provide opportunity to develop competencies in their selection, use, and evaluation.

V. To acquaint teachers with procedures for planning and implementing effective EE programs.

VI. To acquaint teachers with sources of professional help, instructional aids and curricula, and major EE programs at the state, national, and international level.

VII. To provide teachers with an opportunity to develop a rationale, a set of criteria and minimum competencies for selecting, developing, and utilizing outdoor sites.

Objectives used to accomplish these goals are listed under the course materials in the appendices. Student achievements on the objectives are measured in the two examinations: one at the mid-term and one at the end of the term. During the course each student presents a teaching unit on outdoor environmental education that he/she has developed. This provides an opportunity to measure achievement on other course systems.

Lecture/discussion are the primary teaching methods used. There is a one-hour lecture scheduled two-days per week. In addition, there is a weekly two-hour laboratory that focuses on outdoor skills, programs, and classroom activities.

This is an important course because it attempts to integrate the biological aspects and the educational aspects so that students see that both must work together for goal accomplishment.

FW 485, Environmental/Conservation Program Design. This course is the advanced environmental education course that is not required for NREE majors but is strongly recommended because it develops the planning skills for instructional programs in environmental education. The goals of the course parallel those of FW 484 but are taken by the instructor to much greater depth. The goals of the course are:

I. To present a set of goals for EE which may be used as a framework for EE curriculum development, and selection of evaluation procedures.

II. To familiarize students with existing EE programs (formal, non-formal, K-12, adults) and with past, present, and future trends in EE.

III. To develop student skills in preparing and implementing EE programs.

IV. To provide opportunity for students to improve their knowledge of environmental issues, environmental actions, and ecological foundations.

Specific objectives for goal attainment are available in the appendices. (See Appendix D) These objectives are written in a behavioral format.

The dominant teaching method is lecture-discussion, but that method is supplemented by several other important strategies. During the term, the students are required to complete five different projects focusing on goal accomplishment. The first assignment is an analysis of an EE model (case study of the Bighorn Sheep) by the use of a work sheet. The second, again using a work sheet, is to do an analysis of a curriculum entitled "Project Learning Tree." The third assignment is a team project in which the 4-5 member team is to use the competencies of the team to develop a comprehensive curriculum. In addition, each member of the team must develop a unit which contributes to the overall curriculum. The team must also develop a program around a basic concept. The fourth assignment is a written report but again it is the development of five teaching units, two at the same level and three at different age levels. These units must be a subset of the team curriculum and must include performance objectives for cognitive and affective levels.

Two other assignments are also required. In the community resources assignment the students are asked to describe in a two-page paper teaching resource in the community that could be used to meet environmental education goals. In that description, performance objectives and major concepts, attitudes, or skills should also be described. All the anticipated planning around that activity is also part of the assignment. The last requirement is a 2-5 page paper based on a research of primary and secondary sources about some Michigan environmental problem. In the paper, the student is expected to define the problem; give brief history of the problem; summarize the knowledge of the problem; summarize the extent and consequences of the problem; summarize the value positions on the problems and the groups that hold those positions; summarize the past, present and expected actions of important factors for the problem; and then to review the proposed alternatives with a brief evaluation.

Evaluation of the course is weighted toward the assignments with a total of 225 points allocated to the five. The mid-term and the final are both valued at 100 points each for a course total of 425.

Many other courses are also available within Natural Resources for agricultural education students to take. Most of the courses will not be taken by as many students as the four which were described indepth. This is a brief listing of some of the other courses available as electives to agricultural education students:

1. Fisheries and Wildlife

FW	301	W	5 credits	(Fish and Wildlife of North America)
FW	328	W	3 "	(Vertebrate Pest Control)
FW	374	W	3 "	(Biological Oceanography)
FW	376	W	3 "	(Introductory Limnology)
FW	402	F	4 "	(Environmental Conservation Education)
FW	410	F	3 "	(Upland Wildlife Management)
FW	412	F	3 "	(Wetland Ecosystem Management)

Virtually all these courses are available on a choice basis for AES.

Fisheries & Wildlife (con't)

FW	413	F	2	"	(Upland and Wetland Ecosystem Laboratory)
FW	424	S	4	"	(Wildlife Population Analyses)
FW	434	W	4	"	(Wildlife Resource Policy and Management)
FW	485	W	3	"	(Environmental Conservation Program Design)

2. Forestry

FOR	204	FW	5	credits	(Forest Vegetation)
FOR	220	W	3	"	(Plants and Their Environment)
FOR	301	W	4	"	(Quantitative Methods for Natural Resources)
FOR	304	F	4	"	(Forest Ecology)
FOR	409	W	3	"	(Forest Hydrology)
FOR	424	S	3	"	(Forest Soils)
FOR	450	W	4	"	(Natural Resources Administration)
FOR	455	F	4	"	(Natural Resources Economics)
FOR	460	F	3	"	(Arboriculture)

3. Horticulture, Crop Science, and Soil Science

HRT	211	F	4	credits	(Ornamental Trees & Narrow-leaved Evergreens)
HRT	212	S	4	"	(Ornamental Flowering Shrubs & Broad-leaved Evergreens)
HRT	325	S	4	"	(Ornamental Plant Management)
CSS	101	F	3	"	(Crop Science)
CSS	202	S	4	"	(Soil and Our Environment)
CSS	210	FW	5	"	(Fundamentals of Soil Science)
CSS	311	W	4	"	(Soil Management)
CSS	390	W	3	"	(Soil Conservation and Land Use)

4. Park and Recreation Resources

PRR	302	F	3	credits	(Environmental Attitudes and Concepts)
PRR	304	FW	3	"	(Recreation Planning and Design)
PRR	351	FW	3	"	(Park Interpretation & Visitor Information Services I: Principles)
PRR	440	WS	4	"	(Park & Recreation Administration)
PRR	446	WS	3	"	(Park & Recreation Area Operations)
PRR	448	F	3	"	(Field Studies in Park & Recreation Administration).
PRR	499	W	3	"	(Recreation Land Management)
PRR	451	W	4	"	(Park Interpretation & Visitor Information Services II: Methods)

5. Resource Development and Public Affairs Management

RD	417	FS	4	credits	(Land Economics)
RD	420	FWSSu	3	"	(Water Resource Development)
RD	431	FS	3	"	(Law and Social Change)
RD	435	F	3	"	(Law and Resources)
RD	460	W	4	"	(Regional Economics)
RD	470	S	3	"	(Energy Supply and Policy)
PAM	201	FS	3	"	(Introduction to Community Economics)
PAM	260	W	3	"	(World Food, Population and Poverty)
PAM	406	FS	4	"	(Public Expenditures: Theory and Policy)
PAM	462	F	3	"	(Agriculture and Rural Development in Developing Nations)

6. Mininum of 12 credits from at least 2 of the following areas.*

1. College of Natural Science

BOT	201	FS	3	credits	(Plants, People and Environment)
BOT	302	FW	4	"	(Introductory Morphology)
BOT	318	S	4	"	(Introductory Plant Systematics)
BOT	336	S	3	"	(Economics Plants)
BOT	411	Su	4	"	(Systematic Botany)
BOT	450	S	4	"	(Ecology)
ZOL	304	W	3	"	(Biology, Behavior, and Humans)
ZOL	389	W	4	"	(Animal Ecology)
ENT	250	F	3	"	(Pests, Environmental Quality and Ecosystem Management)
ENT	301	FS	3	"	(General Entomology)
ENT	302	FS	2	"	(General Entomology Laboratory)
GLG	201	FSW	4	"	(Earth Processes)
GLG	202	FWS	4	"	(Evolution of the Earth)
GLG	205	F	3	"	(Oceanology - The Marine Environment)
GLG	282	W	3	"	(Energy Resources of the Earth)

Nearly all of the above courses are available to agricultural education students on an elective basis.

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1. Michigan State University *Descriptions of Courses*, (East Lansing, Michigan: Michigan State University, Volume, 80, No. 2, September 1985), pp. A-5.

ENDNOTES

1. The Legislative Service Bureau. Michigan Laws Relating to Education (reprinted from the Michigan Compiled Laws), 1982, pp. 1-2.
2. The Common Goals of Michigan Education, (Lansing, Michigan: Michigan State Board of Education, 1980), pp. 1.
3. Ibid, p. 3
4. Ibid, p. 9
5. Ki-suek Chung, Michigan Educational Statistics, 1981-82, (Lansing, Michigan: Michigan State Board of Education, 1982) pp. 5.
6. The Common Goals of Michigan Education, p. 8.

Major Achievements in the Incorporation of Environmental Education in Agricultural Education

During the past 15-20 years there have been several major achievements related to the intergrating of environmental education into the vocational agriculture programs in Michigan. The general level of societal awareness and concern for environmental issues and problems has been heightened during this period. The institutionalization of rules, regulations, and policies has made it easier for teachers to gather resources, provide examples of good practice, and to conduct effective instruction.

Agricultural Teacher Education

In the early 70's, a major revision was made in the requirements for persons planning to become teachers of agriculture. Even the title of the major was changed from Agricultural Education to Agribusiness and Natural Resources Education (ANRE) as part of the effort to broaden the perspectives of prospective teachers. The prospective teachers were expected to be more sensitive to environmental issues such as contamination of the food chain, water pollution, safe application of chemicals, and many more as well as to help prepare students for careers in agribusiness, not just for farming.

Curriculum Revision

The revision of the curriculum included a new requirement: nine credits from courses offered by four departments in natural resources (Fisheries and Wildlife, Forestry, Parks and Recreation Resources, and Resource Development). These credits were waived if the student elected a teaching minor in Natural Resources and Environmental Education.

Instructors for technical agriculture courses have incorporated more concepts related to environmental sciences. For example, the five credit required course in soils, Fundamental of Soil Science, incorporates, among others, the following topics: Soil Ecology; Fertilizers and Their Use; and Population, Food and Land. In one of the lectures, the students are presented with comparative results of research on organic and conventional farming methods with comparisons on such factors as mean yield (metric tons per hectare), value of crops, operating expenses, and net returns.

A most recent development has been one term (10 weeks) of "hands on experiences" for students at a newly developed facility at the Kellogg Biological Station. Approximately fifty percent of the agricultural education students are electing to participate in the Rural Resources Education Program which provides practical experiences in production agriculture and the natural resources. They receive a strong emphasis on the interrelationships of production agriculture and the natural resources.

Practice Teaching

The practice teaching program has had only minor changes in regard to environmental education. The format of time and administrative arrangements for practice teaching remain essentailly the same. However, the changes are in substance, i.e., in the content of instruction. The agricultural education students, while involved in their 10-week experience, have conducted more instructional units related to environmental education. These have dealt with such topics as the following: maintaining habitat for wildlife; learning to classify land types for management; protective clothing for chemical applications; and planning for the disposal of wastes from the swine enterprise.

In-service Education

The vocational agriculture teachers have had access to many more instructional materials relating to environmental education. These materials have been prepared in many states but have been readily accessible to Michigan teachers through the established networks for interchange of information. The materials have included slide sets, slide-tapes, printed material, etc.

The Michigan Agricultural teachers have been encouraged to take technical courses in the various natural resource areas as part of their graduate programs and/or the programs to upgrade their teacher certification from Provisional to Continuing. In addition, the several non-credit workshops and conferences planned for the teachers of vocational agriculture have included topics and experiences directly related to environmental education. For example, at one of the summer conferences the teachers were provided with a discussion and field trip to get first-hand information about a large waste disposal operation near the city of Muskegon. This operation includes several thousand arces of farmland which receive irrigation water from the plant.

Secondary Vocational Agriculture

Curriculum Revision

The greatest achievement in incorporating environmental education into agricultural education has been through the development of the Michigan curriculum guides. The use of the guides is purely voluntary on the part of teachers. However, their availability and their development by teacher in the State of Michigan means that they are a major resource used by teachers when developing curriculum.

The curriculum guides replace an older list of suggested "performance objectives" which had very little or no attention to the concept of environmental education. The new curriculum guides all have tasks related to environmental education.

Over the past few years there has been a growing recognition of the necessity for expanding the teaching of environmental education. Several different approaches were tried in an attempt to expand the teaching environmental education concepts. One of the approaches tried over the past few years was the development of a separate course under a variety of titles such as "Conservation Education" or "Environmental Education." In many cases, the vocational agricultural instructor was asked to teach these separate courses. These courses enjoyed a brief period of success but soon, for a variety of reasons, were deleted from the course offerings of schools.

The demise of the separate courses for teaching environmental education concepts was followed by an increased integration of environmental education in the subject matter of the traditional vocational agriculture courses. There was no real organized effort that led to this change. The increased attention to concepts concerning the environment were a result of the increased concern of the American public for the environment. The teachers responded to this new concern by the public.

Specific laws and regulations related to the environment have been enacted at all levels of government that regulate the agricultural industry. The modern vocational agricultural teacher cannot do a complete job of instruction by just teaching students how to operate an enterprise efficiently. The teacher must discuss efficiency and proper use of the environment in the same lesson and help students to draw conclusions that lead to a healthy balance between the two important concepts.

FFA Contests/Awards

A review of the awards programs in the Future Farmers of America organization reveals that in recent years two new proficiency awards were added in the areas of environmental education: (1) Farm and Homestead Improvement; and (2) Wildlife Management. These new awards join the older award, Soil and Water Management, to make three awards out of the 29 given in the program.

The leadership awards include Public Speaking, Extemporaneous Speaking, and Farm Forum. The topics chosen by the leaders for these contests have encouraged students to select environmental concerns as well as other topics.

The FFA award program titled Building Our American Communities (BOAC) continues to attract students to activities in improving the environment.

The FFA is a major means for providing movitation to students and it will continue to be one of the means by which even greater efforts will be made to teach environmental education as part of the vocational agriculture program.

Major Constraints in the Incorporation of Environmental Education In Agricultural Education

Change is seldom easy. Changes which require additional expenditures of dollars are especially difficult to accomplish. Changes which require explicit value changes in addition to expenditures of dollars become very complex to implement. Such is the case for incorporating environmental education into agricultural education. The slowly shifting values expressed by the U.S. public toward long-range maintenance and improvement of the environment has been helpful but there is still much resistance.

General

Implementation of environmental education for agricultural education majors at the university has the same constraints as attempts to change technical programs. First, the knowledge base is growing very rapidly in every field. It is difficult for the professor to keep abreast of the developments in his own area of specialization without considering developments in related areas. It has been estimated that to maintain a complete up-to-date awareness of the literature in current publications, a professor would have to read 250 journals each month.

Second, environmental issues are contained in separate discipline. Most agricultural professors may be familiar with only that small portions of environmental service which overlap with their own discipline. Often this obvious overlap is associated with legal provisions (laws, government policies, etc.). In this era when government intrusion is often blamed for current agricultural problems, these regulatory intrusions may be viewed negatively by the professors.

Third, the present limited number of courses in environmental sciences taken by the students are insufficient. However, curriculum committees, administrators and department faculty are reluctant to reduce the number of required credits to be taken in the traditional major fields such as soils, crops, horticulture, agriculture engineering, livestock and dairy. This means that the requirement of 180 credits for the baccaluareate degree either has to be increased or there must be a reallocation of required credits in such areas as general education, computer literacy and communication.

Fourth, many of the students in agricultural education come to the university with very limited practical experiences in agriculture and the natural resources. Some rather progressive universities/colleges are providing or requiring real job experience as part of the undergraduate program. About one-half of the current undergraduates in agricultural education at Michigan State University are electing to spend one term in a newly established practical experience program at the university owned and managed Kellogg Biological Station mentioned previously. It is still too early to assess the effectiveness of that hands-on experience.

Finally, twentieth century American agriculture has a long history of increased resource consumption to maximize productivity. The productivity increases have been supported primarily by increased use of fossil fuels and synthetic chemicals such as fertilizers and pesticides. These materials, viewed by the farmer as the solution to their problems, are viewed by environmentalists as sources of air, water and human pollution. Environmental solutions will require a reversal, or major changes, in the long-term trends in American agriculture.

Teacher Education

The new requirements for nine credits in natural resources courses is minimal. The level of sensitivity of the beginning teachers to the environmental issues is minimal and sometimes insufficient. The remedy probably lies more in the in-service program than in attempts to juggle the proportions of courses taken in the pre-service program. There is a readiness for the instruction after the new teachers get more familiar with the real world as viewed in their school communities. At the present time the financial resources have not been available to plan and conduct an effective in-service program.

Secondary Vocational Agriculture

One of the constraints to incorporation of environmental education into agricultural education at the local high school level is the autonomy of the local schools. Neither the State nor Federal government exercises powers to mandate curricula. Curriculum development has traditionally been a local activity. The reliance on local development and control of curriculum has been one of the strengths of the program. However, the concept of local control of curriculum means that teachers must be convinced of the importance of environmental education, rather than "ordered" to incorporate it, if progress is to be made in expanding the role of environmental education in vocational agriculture.

The priorities of the people in the local community became a very important reality for consideration by the agricultural teachers. The curriculum must have the support of the community. This can be both a strength and a constraint. Environmental Education concepts may or may not be supported by the community depending on the knowledge and commitment of the community. Many of the concepts for improving the environment cost money or time from both private and public institutions.

Often the teacher may be constrained from agressively integrating some environmental education concepts into agricultural education by the lack of support in the local community for a particular concept. That is not to say that anyone can censor what a teacher teaches in his/her classroom, but public opinion is carefully analyzed by the prudent teacher. The teacher cannot be too far out in front of the local community or there is the possibility of losing local support. The problem is most acute in communities with new teachers who have not had th chance to prove their credibility to the community.

Guidelines and Strategies for Incorporating Environmental Education Into Agricultural Education

General

Perhaps a review of some of the history of environmental consenus, legislation, and education in the U.S. will provide a base for some inferences about guidelines and strategies for incorporating environmental education into agricultural education.

Environmental problems from a world perspective are very complex and as a result very difficult to understand and to solve. The United States as a nation has made reasonable progress dealing with some difficult environmental issues over the last century. This has not been made in one long, strong push by the society as a whole. But rather has been made in three distinct surges that reflected the immediate concerns of the citizens of the nation at that time.

The latest surge of the seventies, resulted in the greatest progress under the most difficult circumstances. The nation was in the midst of the devisive Vietnamese war that differentiated the values of the citizens as never before. But the national leadership was convinced that we as a nation could have "guns and butter" which was to say that we could fight the war and have a high quality of life at home also. Part of that high quality of life was environmental quality. It was in that decade of the seventies that crucial pieces of environmental legislation were adopted including the Clean Air Act, Clean

Water Act, the National Environmental Protection Act, and numerous other smaller but significant pieces of legislation which created the background for major environmental progress in a politically divided nation. However, on environmental issues, most of the nation had the same agenda, a quality environment.

The motives of the various groups from environmental to business that supported this legislative thrust were very diverse. Some groups were firmly convinced that the human history was near its end. Others were resource focused with special concerns about water or air. Others were generally focusing on the overall quality of human life. Others were reacting to the war and viewed environmental movements as a very positive movement when negativism was a predominant public view. For whatever diverse values, all these groups coalesced into one dominating political force. Candidates won or lost elections on their environmental platforms. Virtually every evening news program had several minutes for highlighting some environmental problem or a group protesting against a company's waste problems. The result in society was that citizens were made more aware and knowledgeable about environmental issues then ever before.

The impact on the educational system was interesting. During the thirties, out of the second wave, a strong conservation education and outdoor education movement had developed. State educational goals were published that would fit or at least parallel similar goal statements in the seventies. At that time schools were given land laboratories of 20 to 50 acres in size to be used for outdoor or conservation education purposes. This happened in states like Michigan where large land areas had reverted back to the state because of failure to pay taxes during the great depression. Parallel growth occurred in the school camping movement. Thousands of students in grades 6-12 spent one to five days in a camping situation studying nature, conservation practices and recreation in the out-of-doors. Some states established state-wide curriculum requirements. Wisconsin still requires that teachers take a conservation course as part of their teaching certification requirements.

During World War II, school outdoor activities decreased but resumed with some strength in the late forties. By the fifties, conservation courses were available at most teacher training institutions. It was at this time that many groups usually sponsored annual conferences that encouraged and educated teachers about conservation and outdoor education methods. All this background was the growth medium on which the environmental education movement was planted in the late sixties and early seventies.

The environmental quality movement did not grow out of this educational subset. But rather the educational groups quickly responded to the call from the society so that conservation education organizations began changing their names to environmental education organizations as the literature called for the change in emphasis from a natural resource to environmental quality.

Michigan State University was a prime actor in this developmental scenerio of conservation education, outdoor education, and environmental education. The Outdoor Education Institute under the leadership of Julian Smith developed curricula, trained graduate students, and ran teacher training workshops in Michigan and throughout the United States. The Conservation Institute of the fifties grew into the Department of Resource Development. In response to the environmental education movement, the College of Agriculture and Natural Resources responded with a progressive teacher training major to meet an anticipated demand for teachers in public and private schools in the 1970's.

Also at that time the College of Agriculture and Natural Resources changed the name of the major in agricultural education to agribusiness and natural resources education and required the students to take three courses in natural resources as a part of their teaching certification requirements.

The Natural Resources and Environmental Education Major for preparing teachers was successful for roughly a seven-year period. Beginning in 1973, the major began with just a few students (less than ten) in the major. By 1977, the major had almost 200 people enrolled in the four-year program. Because of the change in emphasis for public school programs and the inability to obtain employment fewer than 20 students were enrolled in 1985. In 1983, the administration of the major was transferred to the newly formed Department of Agricultural and Extension Education. The intent of the transfer was to centralize all teaching majors for the College of Agriculture and Natural Resources Department.

Environmental education within the State of Michigan had been actively supported by the Michigan Environmental Education Association. At a conference in the Fall of 1968, the Michigan Conservation Education Association adopted a name change and became the Michigan Environmental Education Association. The organization and operation of the association was strongly supported by the Conservation Education group within the Michigan Department of Natural Resources, a state agency responsible for natural resource and environmental management.

For most teachers, the responsibility for environmental education curriculum development within the State was not clearly defined. The Michigan Department of Education had one person with split responsibility for science education and environmental education. With this minimal commitment, strong leadership from the State Department of Education never occurred. The conservation education personnel within the Michigan Department of Natural Resources numbered two people but they were limited by the lack of support from the agency. In the late seventies, an internal review committee and a strong domineering legislator from the northern part of the State succeeded, by recommendation and threat, to convince the

Michigan Department of Natural Resources that the Department should not be in the education business. That lack of leadership and the minimal funding support for development and implementation of programs inhibited curricula growth.

Despite the abdication of environmental education leadership in the State, environmental education did grow within the State of Michigan because individual teachers and occasionally local school boards supported the development of local curricula. At the grade levels 8-12, the most common approach was to establish a course that focused on environmental issues often entitled "Ecology" or "Environmental Issues." Other teachers taught shorter environmental education units within their regular courses. Few school systems were able to accomplish the ideal integrated, interdisciplinary curriculum that was called for by the current thinkers. However, most of those school districts that did reach the ideal were usually supported by federal or state grants. The grant money was used to plan the program but implementation and continuation of the program was dependent on the interests of the individual teachers. Soon after the funding cycle had been fulfilled, continuation of the instruction became erratic and sometimes non-existent in many schools.

The curriculum development processes of the seventies did yield 5-10 major curriculum projects. The Biological Science Curriculum Series has a strong emphasis on ecological concerns which may be integrated into the high school biology course. Project Learning Tree is another frequently used curriculum.

Another informal system of education within the United States has been more persistent in environmental education programming. The nature centers, sometimes called the environmental education centers, have been the source of regular and continued environmental education programs. These centers are usually small nonformal combination educational and recreational facilities supported by the local community by a private funding organization, or a parks and recreation department, or an intermediate school system, or even a larger well funded school system. These facilites are usually staffed by one of more "naturalists" who develop and run educational programs for school groups, families, senior citizens, or any other group interested in a program. The focus of the programming is usually the natural area on which the facility is located. Their programs would normally be called "nature education," "ecological education," or the older term discussed previously "conservation education." Small museums are commonly found in nature centers with living exhibits, dioramas, pictures, and displays. Trails through the site offer educational stops as visitors walk or cross country ski through the land area.

These nature centers serve as a community center for local citizens interested in environmental concerns. Their facilities are commonly used by local Audubon, Recycling, Energy, and other special interest environmental groups. These local centers serve in the dual role of environmental education service to schools and as a nonformal education support system for adults with environmental interests. These organizations have become the most consistent environmental education programs in the United States.

Some states have taken a more active environmental education approach. The Missouri Department of Natural Resources, a State agency, has 40 field staff to work with teachers, nature centers, and citizen groups in environmental education programming. Wisconsin regularly offers a series of teacher workshops throughout the State to aid teachers in the implementation of environmental education in their classroom. The commitment to environmental education is very dependent on the political environment of each state.

The Federal Government has not supported environmental education directly to any great extent. Indirect support has come to the agricultural community through such organizations as th Soil Conservation Service, Cooperative Extension Service, United States Forest Service, United States Park Service, and the United States Fisheries and Wildlife Service.

The development of environmental education in the United States has clearly delineated certain principles that should be considered for development of programs in other countries. A maximum growth of programs occur when the national government and the state government are financially supportive by designating personnel to provide leadership to the goals of the program. Funding for program development and research will result in a spurt in participation of school systems to prepare and implement programs. In the absence of this leadership the continuation of programming will depend totally on the commitment of local schools, groups, or individuals. Dedicated people can, and should be, supported by regional organizatons that provide regular opportunity for socialization, retraining, and moral support.

Agricultural Teacher Edcuation

Perhaps the most effective means for incorporating envrionmental education into the agricultural teacher education program starts with recognition that it requires support and favorable decisions from both inside and outside of the university. Without the support and leadership from faculty in the departments directly concerned with environmental sciences, there could not have been even the modest beginnings which have been achieved. Those departents planned and taught the courses which serve not only the students in agricultural education but many more students throughout the university.

The support from the Michigan Department of Education (MDE) was essential for making the changes to incorporate environmental education into the pre-service agricultural education curriculum. The professional association for teachers of agriculture, the Michigan Association of Teachers of

Vocational Agriculture (MATVA) was supportive. In the early 70's, there was support from a few school district superintendents in the form of public statements about the qualifications needed for teachers of agriculture, and support for their local programs of vocational agriculture which included environmental education concepts.

Some of the teachers of agriculture were members of the Michigan Educational Education Association (see above). These teachers played an important role both in terms of their local instructional programs and as supervising teachers for the students from the University during the practice teaching experience.

For a period of approximately three years, one agricultural teacher educator at Michigan State University, devoted approximately half of his time, along with a half-time graduate assistant, to preparation of materials and organized in-service education for teachers in elementary and secondary schools to help them incorporiate environmental education into their instructional programs. Some teachers of agriculture were utilized in the in-service programs for these other teachers in the school systems.

The lessons learned indicate that some principles should be observed, such as:

1. The greater the expression of concern for environmental education by many groups and individual leaders in society, the greater the probability of success in incorporating environmental education into agricultural education.

2. There must be specific individuals and organizations with responsibility for environmental education in order to provide the necessary substantive, emotional and social support to the total effort.

3. The concepts for environmental education must receive support and enhancement as integral parts of many courses in addition to the special courses in environmental sciences.

4. The gains made through personal committments to the values of environmental education are more essential to the long-term success than short-term projects with dollar support.

Vocational Agriculture

There are a number of strategies that can be followed to incorporate environmental concepts into the teaching of agriculture at the secondary level. In fact, to increase the probability of having an increase in the teaching of environmental concepts, a number of activities must take place. The teacher, as a leader in the community, is a key person in the plan to get environmental concepts accepted. However, the teacher must understand the mores and standards of the community.

To increase the integration of environmental concepts there must be an acknowledgement by the public that the concept of environmental education is important. There must be at least some concensus on the goal of providing an improved environment for everyone.

The teacher cannot integrate what he/she does not know. There needs to be an ongoing emphasis on expanding the teacher's knowledge base in at least three areas: attitude toward environmental education, environmental science technology, and methods of teaching environmental education.

What teachers do is influenced by how they feel about a particular topic. If teachers are to spend more time learning and teaching environmental education concepts in vocational agriculture, they must believe the topic is important. The rewards that are regularly bestowed on vocational agriculture teachers must include recognition of teachers who have played important roles with environmental education.

Teachers must improve their knowledge base of appropriate environmental technology that can be integrated into a vocational agriculture program. Increased attention must be paid to the highlighting of environmental activities in the technical agriculture courses that teachers take as either formal or nonformal courses, at both the undergraduate and postgraduate levels.

Probably as crucial as anything is the need for assistance to teachers, through their professional education activities on methods of integrating environmental education in the vocational agriculture program. Today, no new construction projects in many part of the U.S. take place without an "environmental impact study" being made. It is just as important for the teacher when constructing a curriculum to also be asked to determine the "environmental impact" of the material to be covered. In fact, it would be a good idea to include this heading in the lesson planning outlines that our teachers follow when developing lessons plans.

It is important to expand the teachers knowledge base through both formal and nonformal education by requiring courses in natural resources and environmental education as a part of the preservice program, the gradaute and noncredit in-service programs; teaching environmental concepts as a part of each technical course in agriculture in the preservice, graduate program and noncredit in-service programs of teachers; and emphasizing the importance of incorporating environmental education into the curriculum of a well balanced vocational agriculture program in the professional teacher education courses and workshops.

The specific procedures that seem to be most effective in aiding teachers to integrate environmental education into the vocational agriculture program are (1) developing curriculum materials that include environmental education concepts as an integral part of the subject matter and (2) conducting workshops where teachers with similar problems, environments, culture and approaches gather to participate in discussions of the procedures that will most likely be successful in teaching the subject. If the teachers themselves have a hand in developing or adapting the materials for their local situation the chances of adoption are greatly improved.

Suggested Documents and Activities to be Developed at the International Level[1]

Much has been written and discussed at the international level regarding environmental education. This has included concern for appropriate strategies for development of environmental education within nations. The following comments and suggestions are offered from the point of view "what should be done at the international level which would enhance the achievements at the national and local levels?"

General

There are levels of environmental problems. The highest order of these problems are global in nature. They are caused by the activities of humans and nature combined. And they impact all human beings to a lesser or greater extent. Examples of these issues include acid rain, population growth, atmospheric pollution, atomic warfare, increased levels of carbon dioxide in the atmosphere, and energy availability and prices. All people of the world need to be aware of these issues and their impact on the human species. In each of the issues there is a "tragedy of small decisions" for which each of us as members of the human species are responsible. These may accumulate into a large sum of activities which could have dramatic impact. These issues are best handled using good communication technology and techniques to raise the overall consciousness of the people throughout the world. For the typical post-secondary student it is imperative that each student be required to take at least one course that deals with these fundamental environmental issues. All students who are preparing to teach agriculture should take at least one course on fundamental environmental issues.

Other problems are more regional. Though they may be of interest to all individuals concerned about environmental quality the individuals that are truly impacted are the resident people. Examples of these issues include desertification, endangered species, clearcutting of tropical forests, soil erosion, fuel wood availability, loss of indigenous peoples, drought, and local warfare. They are unlike the global issues where all nations and states have a stake and the solutions are most likely to come from the United Nations or other larger blocks of countries. Regional problems must be dealt with by the smaller groups of nations immediately impacted. Educational focus for these issues must occur in the regions with the problems.

It is imperative that in the regions where these types of problems are prevalent that the needed research be done to identify the real ecological sources of the problems. When this information base is available, demonstration sites should be established to provide examples of improved practices to the people. Once this base of appropriate technology has been established so that it is reasonably clear that there is a better way, then a communication strategy can be developed and implemented. These strategies should utilize sound communication principles on which there is extensive research. (That could be the topic of another paper.)

A communication/education system, comparable to the Cooperation Extension Service and the vocational agriculture programs in the public schools, is needed to carry the information to those individuals in need. The information/education system must be supported with adequate finances to produce the necessary publications and communication technology. In the hope of achieving a "trickle down" flow of information, the agricultural teacher education programs and the agricultural teachers must occupy a high priority within that system.

Teachers and the Vocational Agriculture Programs

A wide variety of documents and activities have been developed at the international level. There is a need for additional documents to be developed to support the teacher in the classroom. Agricultural teachers should be supported with free or at least inexpensive materials that are easily adapted to their immediate situation. Hands-on training in the use of those materials can be done through regional workshops, national workshops, and local workshops. Satellite television technology can be used effectively to mobilize the expertise with less expense. Effective self-teaching computer programs could be developed to aid the self instruction of teachers. Computer bulletin boards could be encouraged to share teaching ideas between teachers. Area field trips to demonstrate problems and recommend solutions should be available for teacher participation on a quarterly basis.

Perhaps more important than the development of additional documents, or at least as important, is the development of strategies that will lead to the incorporation of environmental education content into the secondary agriculture programs around the world. No single approach will suffice. There must be a variety of approaches that will accommodate regional, cultural environmental and historical differences that exist around the world.

Regional Approaches

Documents and activities developed on the international level need to be developed with the assistance of teachers from regional groupings that are as homogeneous as possible. The developers need documents from all over the world as resources. However, the curriculum materials they develop need to be oriented toward the teachers and the problems of the particular region attacking the task.

Why is the suggested approach so important? Almost all teachers know more than they choose to teach. Certainly, it is always important to help the teacher to add to their knowledge base. However, if the teacher does not incorporate what they learn into their teaching the maximum value of the learning is not realized. Concurrent with learning new information the teachers, who ultimately will incorporate the material into their classroom instruction, must have a change in attitude as well as having the material available.

Documents and activities need to be developed on the international level that will assist regional leaders to help change the attitude and instructional methods of the teachers in the various countries. An example of the type of activity that needs to be developed might be similar to the experience of a number of agriculture science teachers from Trinidad and Tobago.

Trinidad and Tobago wanted to improve the level of trained workforce in agriculture. They had an extensive agricultural science program in the junior and senior secondary schools in the country. However, few students were selecting careers in agriculture after participating in the program.

The Government of Trinidad and Tobago came to realize that work had to be carried out with the agricultural teachers to improve their methods of teaching agriculture. The Government established a new Agricultural Teacher Education Center as part of the Eastern Caribbean Institute for Agriculture and Forestry. Prior to the establishment of the center, three teachers were selected to go to Michigan State University to obtain Masters degrees in agricultural education.

The Agricultural Teacher Education Center opened in the fall of 1983 with its trained staff, a consultant from Michigan State University and twenty experienced agriculture science teachers. A complete curriculum was followed that was designed to increase the knowledge of the teachers for preparing students for entry into agricultural occupations.

The teachers eagerly participated in the learning experience and seemed to be understanding the procedures advocated. However, it became apparent that increased knowledge did mean increased utilization in the classroom. The teachers were impressed with the new concepts but tended to believe the concepts were just more of the "educational abstraction" that properly prepared teachers ought to know. They could not visualize the utilization of the concepts in their own situations.

The three instructors had seen the program in operation in the U.S. and were convinced of its applicability to the situation in Trinidad and Tobago. Teachers in the program felt that the instructors were just trying to impress them with the new approach. Teachers had no models of the new concept to observe. All they had was the word of their instructors and the reading materials printed far away in what they perceived to be a situation unrrelated to their own problems.

The staff realized that if the new concepts were to be accepted by the teachers in the program, more than the knowledge level of the teachers had to be changed. The attitude of the teachers had to be changed. The teachers needed models of other teachers succeeding while using the concepts that they had been studying.

The consultants invited the group of Trinidad and Tobago teachers to travel to Michigan in the U.S. where they participated in a three-week program that included a week-long traveling seminar with Michigan teachers to observe agriculture facilities in Michigan, Wisconsin, and Illinois; placement with a Michigan vocational teacher for several days in order to participate with the teacher in local activities; and seminars with Michigan State University staff in agricultural education to help the teachers put into perspective their experiences. The changes in attitudes were amazing. The teachers from Trinidad were surprised to find that there were teachers who practiced and succeeded using the concepts they had been learning. They began to develop plans for utilizing the concepts they had been learning into their own agriculture science programs.

This example illustrates the importance of teachers being involved in the development process of their programs. Teachers learn much from other teachers. Models have to be available in real life situations that teachers can relate to their own situation.

Recognizing National and Regional Differences

The more homogeneous the group that is developing materials the more likely the target group will adopt the materials and procedures. On a world wide basis the discrete groups that ought to be developing materials for use in the classroom will vary greatly. In some areas, the groups may be a series of nations that share common problems, concerns and cultural origins. In other areas the group developing materials must be sub-units of nations. The important factor is the involvement of teachers themselves in the development process and to have models available for teachers in the program to observe.

The materials needed for regional meetings are resources that teachers can rework to suit the procedures and practices of the teachers in the region. This means that international environmental education materials need to be available to selected groups of teachers who then are given the responsibility, under the leadership of an environmental education/agriculture education professional, to develop materials as resources for teachers in their region.

1. UNESCO. Intergovernmental Conference on Environmental Education, Tbilisi (USSR), 14-26, October 1977: Final Report, (Paris: UNESCO, ED/MD/49, April 1978), pp. 19-23.

Conclusions

Agricultural education can be one of the ways to achieve the adoption of practices to maintain and improve the environment. The agricultural education programs conducted in Michigan public secondary schools have contributed to the effective teaching of environmental education concepts. The following conclusions are supported by the experiencs in Michigan with incorporating environmental education into the vocational agriculture curriculm and teacher education in agriculture.

1. There was present a critical mass of people, material and technology in the area of conservation education/environmental education (mainly at Michigan State University and the Michigan Department of Natural Resources) prior to the initiation of changes in curricula for preparing teachers and in curriculua at the local schools.

2. The Michigan education system, with its characteristics of decentralization and local responsibility, made it essential that the strategy for change utilize local leaders in significant roles.

3. The various national movements for improving the environment with their attendant coverage by mass media (newspapers, magazines, radio and television) were positive factors for the incorporation of environmental education concepts into the agricultural teacher education program and into the high school vocational agriculture curricula.

4. The developments for incorporating environmental education into both the agricultural teacher education program and the high school vocational agriculture programs occurred in an evolutionary way rather than as a result of a "master plan" or "master planning."

5. The Michigan Department of Education provided a supportive environment for local initiative in curriculum change, in-serivce education, and development of curriculum materials which enhanced environmental education.

6. The problem solving orientation of the vocational agriculture programs, with emphasis on supervised occupational experiences and the use of the vocational youth program known as the Future Farmers of America, enhanced and encouraged the adoption of environmental concepts.

7. The trend toward enrollment in agricultural teacher education program of students with very limited practical experiences either on farms or in rural areas will require future changes in the curriculum. (This will probably mean a requirement for practical experiences through an internship or field-based courses, or some combination of both).

The vocational agriculture program in Michigan has made a slow but effective move toward integrating more environmental educaton concepts into the local vocational agriculture program. The increased involvement of vocational agriculture instructors is result of (a) an increased awareness of the public of the value of conserving and improving the quality of our environment; (b) an improved understanding of how environmental concepts are important in the agriculture industry; and (c) improved materials and procedures for teachers to use to integrate environmental concepts into their vocational agriculture program.

Teachers of agriculture have always taught a set of environmental concepts in their classes. However, the pressures of modern life require that additional emphasis be placed on integrating more environmental education into vocational agriculture. Progress has been made, but there is still more that must be done to help teachers maximize their potential for teaching students to make wise decisions concerning the environment.

Appendices

A. Requirements for the major in Natural Resources and Environmental Education

B. FW 203 Course Description

C. NR 221 Course Description

D. FW 435 Course Description

APPENDIX A

Effective Spring, 1985 Printed Spring, 1985

Requirements for the Major in Natural Resources and Environmental Education

I. University Requirements (ATL - American Thought and Language, SS - Social Science, HUM - Humanities)

ATL	1-1 FWS	3	credits	ATL	1-2 FWS	3	credits	ATL	1-3 FWS	3	credits
SS	2-1 FWS	4	"	SS	2-2 FWS	4	"	SS	2-3 FWS	4	"
HUM	2-1 FWS	4	"	HUM	2-2 FWS	4	"	HUM	2-3 FWS	4	"

II. College Requirements

A. EC 200 or EC 201 FWSSu 4 credits

B. Two courses - one emphasizing speaking and one emphasizing writing from the following:

ADV 327, AEE 401, COM 100, 115, 326, ENG 213, 230, 303, 312, 313, JRN 201, 300, LBS 131, 232, THR 223 or 1 Yr. For. Lang

C.	MTH 108	FWSSu	5	credits	(College Algebra and Trigonometry I & II)
	MTH 109	FWSSu	5	"	
	or				
	MTH 108	FWSSu	5	"	(College Algebra and Trigonometry I & Finite Mathematics with Applications)
	MTH 110	FWSSu	5	"	
	or				
	MTH 111	FWSSu	5	"	(College Algebra with Trigonometry)
D.	CEM 140	FWSSu	2	"	(Introductory Chemistry)
	CEM 141B	FWSSu	4	"	(Chemical Principles)
	CEM 161	FWSSu	1	"	(Introductory Chemistry Laboratory)
	CEM 143	FSSu	4	"	(Introductory Organic Chemistry)
	or				
	CEM 151	FW	4	"	(Principles of Chemistry I)
	CEM 161	FWSSu	1	"	(Introductory Chemistry Laboratory)
	CEM 143	FSSu	4	"	(Introductory Organic Chemistry)
E.	CPS 115	FWSSu	3	"	(Introduction to Computing)
	or				
	CPS 120	FWSSu	3	"	(Computer Programming for Engineers and Scientists)

F. One course in the Biological Sciences: LBS 140 (FW)

III. Requirements for Natural Resources and Environmental Education

A. Core Courses

FW 203	FWSSu	3	credits	(Resource Ecology)
RD 301	FWSSu	3	"	(Conservation of Natural Resources)
PRR 213	FS	3	"	(Leisure and Recreation Resources)
FW 305	W	3	"	(Principles of Fisheries & Wildl. Management)
FOR 202	FS	3	"	(Introduction to Forestry)
FW 484	F	4	"	(Outdoor Environmental Education)
FOR 491	S	3	"	(Natural Resources and Modern Society)

B. Specialization and Optional Courses. Specialization requires a minimum of 10 credits from a selected area. A minimum of 10 optional credits must be divided between any two or more course groupings.*

1. Fisheries and Wildlife

FW 301 W	5 credits	(Fish and Wildlife of North America)
FW 328 W	3 "	(Vertebrate Pest Control)
FW 374 W	3 "	(Biological Oceanography)
FW 376 W	3 "	(Introductory Limnology)
FW 402 F	4 "	(Environmental Conservation Education)
FW 410 F	3 "	(Upland Wildlife Management)
FW 412 F	3 "	(Wetland Ecosystem Management)
FW 413 F	2 "	(Upland and Wetland Ecosystem Laboratory)
FW 424 S	4 "	(Wildlife Population Analyses)
FW 434 W	4 "	(Wildlife Resource Policy and Management)
FW 485 W	3 "	(Environmental Conservation Program Design)

2. Forestry

FOR 204 FS	5 credits	(Forest Vegetation)
FOR 220 W	3 "	(Plants and Their Environment)
FOR 301 W	4 "	(Quantitative Methods for Natural Resources)
FOR 304 F	4 "	(Forest Ecology)
FOR 409 W	3 "	(Forest Hydrology)
FOR 424 S	3 "	(Forest Soils)
FOR 450 W	4 "	(Natural Resources Administration)
FOR 455 F	4 "	(Natural Resources Economics)
FOR 460 F	3 "	(Arboriculture)

3. Horticulture, Crop Science, and Soil Science

HRT 211 F	4 credits	(Ornamental Trees & Narrow-leaved Evergreens)
HRT 212 S	4 "	(Ornamental Flowering Shrubs & Broad-leaved Evergreens)
HRT 325 S	4 "	(Ornamental Plant Management)
CSS 101 F	3 "	(Crop Science)
CSS 202 S	4 "	(Soil and Our Environment)
CSS 210 FW	5 "	(Fundamentals of Soil Science)
CSS 331 W	4 "	(Soil Management)
CSS 390 W	3 "	(Soil Conservation and Land Use)

4. Park and Recreation Resources

PRR 302 F	3 credits	(Environmental Attitudes and Concepts)
PRR 304 FS	3 "	(Recreation Planning and Design)
PRR 351 FW	3 "	(Park Interpretation & Visitor Information Services I: Principles)
PRR 440 WS	4 "	(Park and Recreation Administration)
PRR 446 WS	3 "	(Park & Recreation Area Operations)
PRR 448 F	3 "	(Field Studies in Park & Recreation Admin.)
PRR 449 W	3 "	(Recreation Land Management)
PRR 451 S	4 "	(Park Interpretation & Visitor Information Services II: Methods)

5. Resource Development and Public Affairs Management

RD 417	FS	4	credits	(Land Economics)
RD 420	FWSSu	3	"	(Water Resource Development)
RD 431	FS	3	"	(Law and Social Change)
RD 435	F	3	"	(Law and Resources)
RD 460	W	4	"	(Regional Economics)
RD 470	S	3	"	(Energy Supply and Policy)
PAM 201	FS	3	"	(Introduction to Community Economics)
PAM 260	W	3	"	(World Food, Population and Poverty)
PAM 406	FS	4	"	(Public Expenditures: Theory and Policy)
PAM 462	F	3	"	(Agriculture and Rural Development in Developing Nations)

C. Minimum of 12 Credits from at least 2 of the following areas.*

1. College of Natural Science

BOT 201	FS	3	credits	(Plants, People and the Environment)
BOT 302	FW	4	"	(Introductory Morphology)
BOT 318	S	4	"	(Introductory Plant Systematics)
BOT 336	S	3	"	(Economic Plants)
BOT 411	Su	4	"	(Systematic Botany)
BOT 450	S	4	"	(Ecology)
ZOL 304	W	3	"	(Biology, Behavior, and Humans)
ZOL 389	W	4	"	(Animal Ecology)
ENT 250	F	3	"	(Pests,Environmental Quality and Ecosystem Management)
ENT 301	FS	3	"	(General Entomology)
ENT 302	FS	2	"	(General Entomology Laboratory)
GLG 201	FWS	4	"	(Earth Processes)
GLG 202	FWS	4	"	(Evolution of the Earth)
GLG 205	F	3	"	(Oceanology-The Marine Environment)
GLG 282	W	3	"	(Energy Resources of the Earth)

2. College of Social Science

ANP 100	FWSSu	4	credits	(Human Evolution)
ANP 171	FWSSu	4	"	(Introduction to Sociocultural Anthropology)
ANP 250	F	4	"	(Culture, Environment and Adaptation)
ANP 263	F	4	"	(Origin of Civilization: Archaeology)
ANP 285	W	4	"	(Anthropological Perspective on Global Interdependence)
ANP 419	FWS	4	"	(Studies in the Anthropology of the New World)
ANP 483	FS	4	"	(Culture and Personality)

GEO	206	FWSSu	4	credits	(Physical Geography)
GEO	206L	FWS	1	"	(Physical Geography Laboratory)
GEO	307	S	3	"	(Geography of Environmental Quality)
GEO	320	F	3	"	(Geography of Population)
GEO	351	F	3	"	(Weather and Climate)
GEO	407	FS	3	"	(Michigan)
GEO	429	WS	3	"	(Landforms of North America)
SOC	241	FWSSu	4	"	(Introduction to Sociology)
SOC	251	FWSSu	4	"	(Social Psychology)
SOC	310	FW	4	"	(Social Stratification)
SOC	329	FWS	4	"	(Urban Sociology)
SOC	332	WS	4	"	(Behavior of Youth)
SOC	420	FW	4	"	(Dynamics of Population)
SOC	437	FS	4	"	(Rural Sociology)
UP	231	FSSu	4	"	(Evolution of Urban Communities)
UP	400	F	3	"	(Urban Development and Planning)
UP	471	F	3	"	(Ecological Basis for Planning)

3. Other Courses.*

AET	421	S	4	credits	(Electrical Energy Utilization)
BCM	200	FWSSu	3	"	(American Housing and Building Industry)
CE	280	FWS	4	"	(Introduction to Environmental Engineering)
FCE	337	F	3	"	(Energy Utilization in the Household)
ME	304	S	3	"	(Technology and Utilization of Energy)
PAM	473	S	3	"	(Introduction to Systems Analysis)
PHY	256	S	4	"	(Energy Consumption & Environmental Quality)
SYS	410	W	3	"	(Systems Methodology)

IV. Teacher Certification Requirements:

A.	TE	200	FWSSu	5	credits	(Individual and the School)
	TE	322	FWS	2	"	(Methods of Teaching-Secondary Common -- Elements)
	TE	337	FS	3	"	(Methods of Teaching-Secondary Subject Areas: Science)
	TE	450	FWSSu	5	"	(School and Society)
	TE	470	FWS	15	"	(Student Teaching) (Sign up one year in advance)
	TE	412	FWS	5	"	(Reading in the Content Areas of the Secondary Level)
		or				
	ENG	408A	FWS	5	"	(Problems in the Teaching of Reading)

B. **Teaching Minor:** Must be selected by the beginning of your junior year. Specific requirements are listed in the College of Education Section of the Academic Programs Catalog.

Minor

List of courses for minor:

V. Electives: 6-33

Total: 180

*Specific courses selected to be approved by the academic advisor.

FW 203 Winter 1986 Tentative Schedule

JANUARY 6 - CLASS INTRODUCTION

During this class time we will be discussing the course goals and objectives, evaluation and grading methods, the use of TV as a teaching medium, and get to know each other a little better. With the remaining time, we will initiate a discussion of a model that we will use over the course of the term to create a common basis for all future discussions.

JANUARY 8 - TIME OF MAN, (not available for viewing off-campus)

This is a dynamite movie! This movie explores a variety of organism/environmental relationships from dinosaurs to current animals. But the real emphasis is the focus on humans from primitive to modern as different responses occur to divergent environmental situations. Lastly, the movie considers the impact of technological change and population growth during the twentieth century. Since the film is a few years old, it allows us to evaluate progress to the present time. This presentation has the best historical montage' that I have ever seen. Try your historical trivia skills by naming the people and events that you observe. Please read Chapter 1 of your textbook.

JANUARY 10 - THE HISTORICAL PERSPECTIVE

From this combination of guest lecture and my own input, I want you to understand the impact that the natural resources have had in the course of human affairs. This impact is largely forgotten as we study the rise and fall of kingdoms. But a favorable environment, with its natural resources, favors or inhibits the flow of political power. Your reading is in Chapter 2 of your text.

JANUARY 13 - KEPONE: AN ENVIRONMENTAL CASE STUDY

Dr. William Cooper, Chairperson of the Department of Zoology and the Michigan Environmental Review Board clearly describes the difficult task of environmental clean up after a company knowingly creates an environmental disaster. This case study clearly illustrates that toxic contamination sites are very expensive to clean up, that the impact is increased or decreased depending on the site of contamination, and reaffirms that clean up cost is much more expensive than pollution control.

JANUARY 15 - LIMITING FACTORS

Plants and animals, humans included, are able to live in particular places because they are able to survive as individuals. If that environment changes, the organism must adapt or die. If organisms are no longer found, then we can conclude that the situation has changed. As a result, we can make some judgements on environmental quality by the types of organisms found in an ecosystem or the changes in the population structure of the organism. Read Chapter 3 in your text.

JANUARY 17 - MEASURING TOXICITY AND RISK

Measuring toxicity of chemicals is a direct application of tolerance range. We will explore what tests are used. Many new terms will be presented to familiarize you with some of the terminology that has become common, so that you can read with knowledge. Risk is the hot word in evaluating toxic problems. You need to know what risk involves so that you can minimize yours. Chapters 17 and 18 is your reading.

JANUARY 20 - POPULATION DYNAMICS (portions of this class will not be shown off-campus)

Groups of individuals have different characteristics. Growth rates, density, and age categories help us interpret the relationship of the organism to its environment. Even though organisms have an unbelievable ability to grow in numbers, they can become extinct if improperly managed. Read Chapter 6.

JANUARY 22 - HUMAN POPULATIONS

Limiting factors prevent biotic potential from being reached in humans as well as other organisms. Yet, the human population continues to grow. Only nuclear war has more potential impact on the environment than does population growth. We will look at age structure, demographic transition, fertility-rates, and marriage age. Please read Chapter 7.

JANUARY 24 - CHINA'S ONLY CHILD (not available off-campus)

If you are the most populous country in the world, and you realize that your future as a nation is in jeopardy? How do you deal with the problem? This NOVA program may be one of the most emotional experiences of your life as you observe individual rights being blatantly violated to achieve the necessity of decreased population growth.

JANUARY 27 - DISCUSSION, ABORTION, SEX AND OTHER BORING, NON-CONTROVERSIAL TOPICS IN THE CONTENT OF POPULATION GROWTH

In this class period we want to explore with some guests the different value sets that people have on the population issue.

Exam Review to be scheduled.

JANUARY 29 - Midterm Exam - location to be announced.

JANUARY 31 - BIOGEOCHEMICAL CYCLES

Every element has its own unique cycle. Human production/consumption systems operate as if materials are a flow resource. Pollution of air and water is an excess of a material that is part of a biogeochemical cycle. We will use water, nitrogen, and phosphorus to illustrate the different types of cycles and human pertebations which create problems and opportunities for us. Read Chapter 4 in preparation for class.

FEBRUARY 3 - EUTROPHICATION IN LAKES

This is the classic example of human activities changing nutrient flow patterns resulting in a dramatic decrease in lake quality. Nutrients accumulating in lakes cause excessive plant growth, depletion of oxygen, and changes in the types and numbers of aquatic species. Chapter 20 is appropriate reading.

FEBRUARY 5 - SOLID WASTE MANAGEMENT

Using landfills as a repository of materials has created for Michigan a multi-billion dollar groundwater cleanup problem. However, dealing with 10 million tons of materials every year in our State, that currently go into landfills, will not be easy or inexpensive. We will explore the alternatives and the costs. Chapter 20 is your reading assignment.

FEBRUARY 7 - HAZARDOUS WASTE AND RCRA

Each individual uses about 160 pounds of hazardous waste in the home every year. Most of that materials goes down the drain or into a landfill contributing to groundwater pollution. Industry produces much more. We will discuss some alternatives and the recent rule changes in the Resource Conservation and Recovery Act that will change the flow of waste to the environment. Continue reading Chapter 22.

FEBRUARY 10 - DEALING WITH CONTAMINATION SITES

The news carries constantly information about another waste site that has been discovered. To date superfund, despite all the press has cleaned up only six sites. You will see in this lecture by a man who worked in the Berlin and Farro Clean up that the process is expensive and difficult. Reaffirming the assertion that prevention is less expensive then clean up.

FEBRUARY 12 - ENERGY'S PHYSICAL PRINCIPLES

The laws of thermodyanmics regulate our lives. We will describe and apply these laws to examine their impact on environmental concerns.

FEBRUARY 14 - ENERGY FLOW IN NATURAL SYSTEMS

Available energy is the ultimate limiting factor for all organisms. Understanding how energy flows explains why most people of the world eat rice and why eagles were the indicators of DDT contamination. Re-read Chapter 4 for this lecture.

FEBRUARY 17 - WORLD FOOD PRODUCTION

Dr. Sylvam Wittwer, Professor Emeritus and Director of the MSU Ag. Exp. Station presents an affirmative view of future agricultural production as many new technologies are applied to crop and animal production. As you listen, specifically identify the environmental and resource concerns that are presented. Read Chapter 9, please.

FEBRUARY 19 - DOWN ON THE FARM (not available off-campus)

Though the U.S. leads the world in food production, the costs are high both environmentally and socially. This excellent NOVA program will give you another point of view. Please read Chapter 9.

FEBRUARY 21 - WORLD ENERGY PRODUCTION, Dr. Tom Edens, Resource Development

You may be saying who's concerned about energy isn't the price going down? This decrease in prices is simply a short-term market aberration. This world has gone through a drastic change in the use of energy causing the decrease in price. We will discuss what the impacts of that change has been and what future changes are likely to occur. Read Chapter 13.

FEBRUARY 24 - ACID RAIN (not available off-campus)

Producing energy from coal has changed the pH of the rain causing degradation of lakes and forests in Canada, eastern United States, and Europe. This excellent NOVA clearly examines the evidence and the impacts. Please read Chapter 19 on air pollution.

FEBRUARY 26 - THE FUTURE OF NUCLEAR POWER

Dr. Bruce Wilkinson from Chemical Engineering will discuss the nuclear power alternative.

FEBRUARY 27 - ENVIRONMENTAL CHANGE OR NOTHING STAYS THE SAME LONG

Nature is constantly in a state of change through a process called succession. This process has impact on animal populations, food production and land use patterns. But the difficulty is politics.

MARCH 3 - THE ROLE OF PERSONAL ACTIONS

How does an activist view and respond to environmental issues? I think that you will find our guest lecturer very stimulating even if you don't agree with everything she says.

MARCH 5 - DO WE REALLY UNDERSTAND GROWTH

This lecture exams the truth of growth as applied to energy population, land use and other issues. I think that you will find the examples and conclusions interesting.

MARCH 7 - CLASS SUMMARY

For me this is the most difficult class of all.

FINAL EXAM- Section 1, Thursday, March 13, 1986, 5:45-7:45 p.m.
Section 2, Wednesday, March 12, 1986, 3:00-5:00 p.m.

FW 203
Resource Ecology
Winter Term 1986

Instructor: David I. Johnson
Teaching Assistant: Jan Kalina

Welcome to Resource Ecology! We hope that you have had a good winter break and are ready to get back to work. Winter break from a study perspective is usually the most productive because you have less distractions and it is shorter. And, of course, you are always anticipating spring break. During the winter, there is the strong urge not to go to class when that strong northern wind is blowing. This class is perfect for dealing with that dilemma because of the variety of viewing options.

Even if you realize the many viewing options, you still may be concerned about a class that utilizes the impersonal TV medium for which we all have a love/hate relationship. What this medium offers to you and to me is instructional versatility that cannot be matched in any other way. We can provide a live classroom in which I will be here most everyday for those of you who want the personal contact. In addition, you have the option of watching ITV on campus several other times or in the convenience of your own home via cable. If you miss all the other opportunities, you can go to the library to view a taped version. By the way, others have found the tapes to be very useful for test review or re-writing notes. Use of TV allows me to use guest lecturers and informational programming that would not be available any other way. Obviously, we will be using prerecorded materials as well as some field trip activities without having the hassle of the travel arrangements, the extra cost, and so on. Because of copyright laws, some of the pre-recorded materials may only be seen on campus, so if you plan to watch at home and the class is not being played, check your outline first and then call your cable company or WKAR.

The course is best described as an introduction to environmental science. That means we survey many different environmental concerns but we trade off depth in the process. When you have completed the course, you should have a good understanding of the major current environmental issues.

THE COURSE GOALS ARE:

1. To create an ecological background for you to evaluate environmental problems.

2. To examine the roots and long-term consequences of current environmental concerns.

3 To recommend short and long-term solutions for these problems.

Major contribution to goal accomplishment will be through the reading of your textbook. The textbook we have chosen is an excellent one. Environmental Science; A Frame Work for Decision Making provides good reading, many inserts and editorial opinion to expand different topics, and discuss potential solutions as additional readings. We will provide chapter objectives to aid your study of the text. In lecture, we will not be reiterating the book content but amplifying and developing ideas that have been shorted or inadequately explained. Be sure that you pay attention to the graphics in your text because they communicate ideas that may not be found in the written section. Some of our test questions will ask you to interpret or recognize graphs similar to those in your book.

If you are unable to make the live 11:30 class time in Room 145 Com., the class will be available several other times during the day. The class will be available in Room 146 Giltner and 208 West Intramural at 1:50, on campus Channel 11 and United Cable, Channel 20 or Continental Cable Channel 31. It will be repeated at 6:00 p.m. on campus channel 11 in Room 148 Natural Resources. At this same time, class will also be on United Cable Channel 20 and Continental Channel 20 and Continental Channel 31. On Sunday morning, at 9:10, 10:10, and 11:10. Monday, Wednesday, and Friday's lectures will be repeated on Channel 11 on campus in G-31 Hubbard or 102 Wonders. United and Continental carry these rebroadcasts also on Channels 20 and 31 respectively. Lastly, all lectures are videotaped and available on the fourth floor of the Library. NOTE ON YOUR COURSE OUTLINE THE TIME DURING THE TERM BECAUSE WE ARE USING COPYRIGHTED MATERIAL WE CANNOT BROADCAST OFF CAMPUS, BUT THEY ARE AVAILABLE IN THE LIBRARY.

Grading will be based on two exams, and two one page papers. 100 points for the first exam, 200 points for the final, and 100 points for each paper for a total of 500. Further information on the paper topics will be made available during the term.

Office Hours are as follows:

Dr. Johnson	8:30-11:00, Monday, Wednesday, and Friday, other times by appointment only.
Jan Kalina	10:00-11:00, Monday, Wednesday, and Friday

I'm glad that you have chosen to join us. If you have any concerns or frustrations, please talk to me about it. I try hard and love to teach, but I'm not perfect. If you don't tell me or my assistant, we will never know and as a result cannot deal with the problem.

DIJ/12/26/85

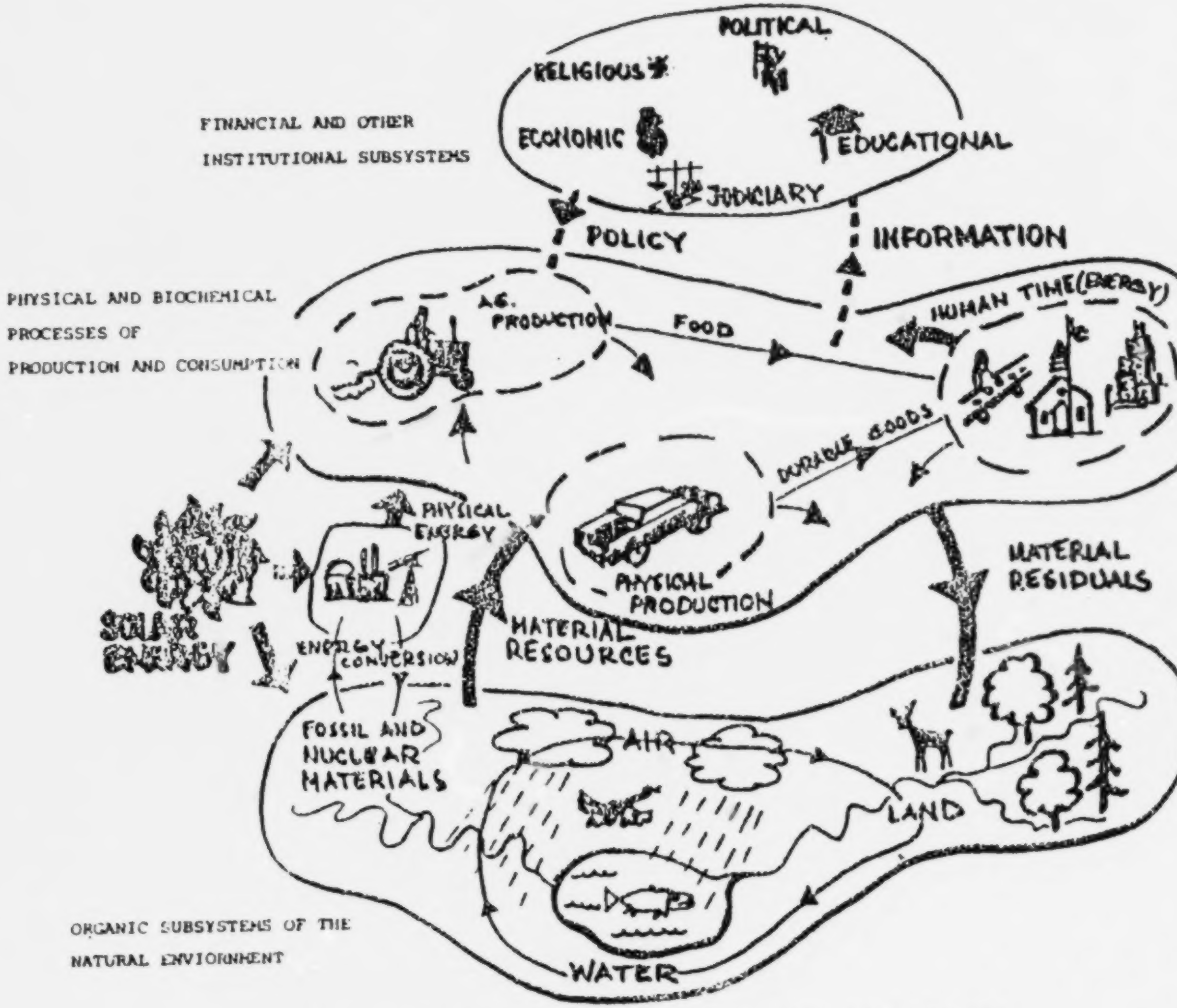

FINANCIAL AND OTHER
INSTITUTIONAL SUBSYSTEMS
RELIGIOUS
POLITICAL
ECONOMIC
EDUCATIONAL
JUDICIARY
POLICY
INFORMATION
PHYSICAL AND BIOCHEMICAL
PROCESSES OF
PRODUCTION AND CONSUMPTION
AG. PRODUCTION
FOOD
HUMAN TIME (ENERGY)
DURABLE GOODS
PHYSICAL ENERGY
PHYSICAL PRODUCTION
SOLAR ENERGY
ENERGY CONVERSION
MATERIAL RESOURCES
MATERIAL RESIDUALS
FOSSIL AND NUCLEAR MATERIALS
AIR
LAND
WATER
ORGANIC SUBSYSTEMS OF THE
NATURAL ENVIORNMENT

Figure 2. Conceptual elements of the relationship of human societies and their natural environment.

A. What are toxic substances (toxicants)?

1. Chemical substances that may present an unreasonable risk of injury to health or to the environment.

2. A substance that kills or injures an organism through its chemical or physical action or by altering its environment.

B. Other terminology

toxicology - - study of toxicants and their action or effects on living systems, i.e., the science of poisons

environmental toxicology - - study of the effects of toxic substances occurring in both natural and manmade environments.

xenobiotic - - any substance which is "foreign" to living systems

toxin (biotoxin) - - a toxicant of biological origin or natural occurrence

toxicity - - the quality or degree of being poisonous or harmful to plant or animal life; refers to the amount of toxicant that causes toxic effects, e.g., mg/kg body wt. or ppm in diet (dose)

acute toxicity - - toxic effects from a single dose or multiple doses over a 24 hour period

chronic toxicity - - toxic effects from a prolonged exposure over $\geq 67\%$ of the lifetime

teratogenic - - effects which cause malformation of the embryo (fetus)

mutagenic - - effects which cause chromosome alterations and thus alter genetic characteristics of cells

carcinogenic - - effects which cause cancer, the disordered growth of cells which can invade and destroy tissues; characteristically causes formation of cell masses called tumours.

LD_{50} - - the lethal dose (LD) of a toxicant that will kill 50% of the test organisms (used for rats, mice or dogs where dose is administered by injection or ingestion and not for aquatic organisms where toxicant is in the water).

LC_{50} - - the lethal concentration (LC) or quantity of a toxicant that kills 50% of the test organisms when in the feed for animals or in the water for fish or other aquatic organisms.

TD_{50} - - the dose at which 50% of the individuals treated exhibit toxic effects

ppm - - "parts per million"; 1 ppm = 1 mg/kg or 1 lb per 1,000,000 lbs; 1% = 10,000 ppm

ppb - - "parts per billion"; 1 ppb = 1 µg/kg; 1 ppm = 1,000 ppb

Table 2-1. A CLASSIFICATION OF TOXICITY-INFLUENCING FACTORS (Casarett and Doull, 1975).

1. Factors Related to the Toxic Agent

   Chemical composition (pH, choice of anion, etc.)
   Physical characteristics (particle size, method of formation, etc.)
   Presence of impurities or contaminants
   Stability and storage characteristics of the toxic agent
   Solubility of the toxic agent in biologic fluids
   Choice of the vehicle
   Presence of excipients: adjuvants, emulsifiers, surfactants, binding agents, coating agents, coloring agents, flavoring agents, preservatives, antioxidants, and other intentional and nonintentional additives

2. Factors Related to the Exposure Situation

   Dose, concentration, and volume of administration
   Route, rate, and site of administration
   Duration and frequency of exposure
   Time of administration (time of day, season of the year, etc.)

3. Inherent Factors Related to the Subject

   Species and strain (taxonomic classification)
   Genetic status (littermate, siblings, multigeneration effects, etc.)
   Immunologic status
   Nutritional status (diet factors, state of hydration, etc.)
   Hormonal status (pregnancy, etc.)
   Age, sex, body weight, and maturity
   Central nervous system status (activity, crowding, handling, presence of other species, etc.)
   Presence of disease or specific organ pathology

4. Environmental Factors Related to the Subject

   Temperature and humidity
   Barometric pressure (hyper- and hypobaric effects)
   Ambient atmospheric composition
   Light and other forms of radiation
   Housing and caging effects
   Noise and other geographic influences
   Social factors
   Chemical factors

FW 203

Chapter 7 - Study Objectives

- What are some of the intrinsic factors that can limit animal populations?
- Why is it necessary to reach zero population growth?
- Know the three opposing viewpoints on population control and what each one advocates as a solution.
- Be familiar with the different methods of birth control and their characteristics.
- Why is it necessary for developed countries to control their populations?
- What are some of the reasons people do not use birth control even though it is available and they know how to?
- Be familiar with the ethical questions and the encouraging and discouraging trends involved with population growth.

FM 203

"China's Only Child"

Questions to keep in mind while viewing the film:

1. What are the specific problems of China's agricultural base which make continued population growth of particular concern to Chinese authorities?

2. What measures, in addition to the "One Child Policy," will decrease population growth in China?

3. When will population growth in China level out under the "One Child Policy?"

4. What are the means by which couples are convinced to restrict their number of children? Which of these methods might also work in other cultures or societies?

5. Population growth in some European countries has reached, or nearly reached, zero. This has not happened because of a "One Child Policy." Speculate on how ZPG was reached in these societies.

6. Relate China's "One Child Policy" to the current social and economic conditions in the country. How has population density affected "freedom of choice?"

POPULATION ECOLOGY

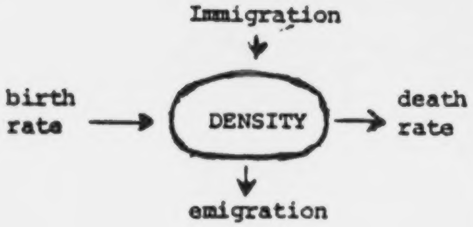
I. THE POPULATION AS PART OF THE BIOLOGICAL HIERARCHY

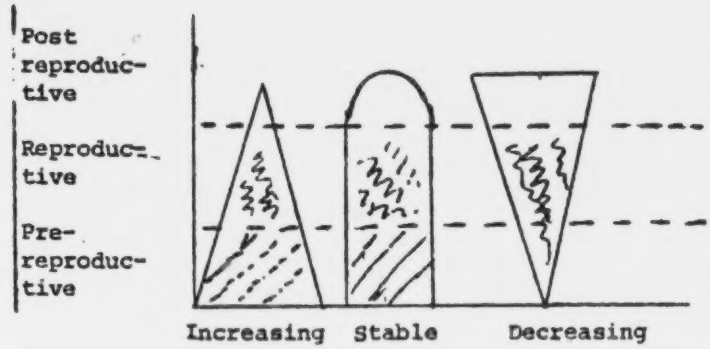
MOLECULES → PROTOPLAS → CELLS → TISSUES → ORGANS → ORGANSYSTEMS → ORGANISMS → POPULATIONS → COMMUNITIES → ECOSYSTEMS → ECOSPHERE

on-life Life

II. POPULATION CHARACTERISTICS

1. Populations have density
2. Determinants of Population size, birth rate, death rate, immigration, emigration.
3. Other characteristics - age distribution, genetic structure, group behavior, dispersion.

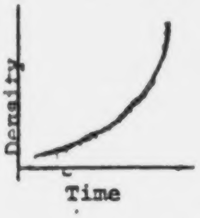

Immigration
birth rate
DENSITY
death rate
emigration


Post reproductive
Reproductive
Pre-reproductive
Increasing
Stable
Decreasing

III. POPULATION GROWTH

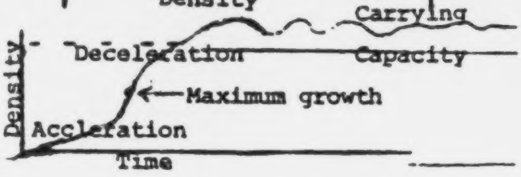
1. Unlimited (exponential) growth

$$\frac{\text{CHANGE IN DENSITY}}{\text{CHANGE IN TIME}} = \text{GROWTH RATE X DENSITY}$$



2. RESTRICTED(logistic) growth

$$\frac{\text{CHANGE IN DENSITY}}{\text{CHANGE IN TIME}} = \text{GROWTH RATE X} \left| \frac{\text{Carrying Capacity-Density}}{\text{Density}} \right| \text{X Den:}$$

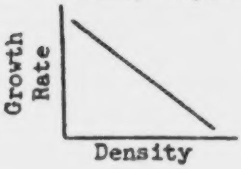


What affects growth rate?

1. Birth rate - fecundity, age structure, age at first reproductive activity (i.e., marriage age).
2. Death rate - age structure, density dependent and independent factors.

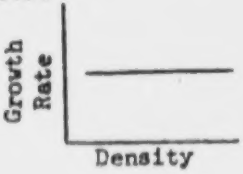
HOW ARE POPULATIONS REGULATED?

1. Density dependent vs. independent factors



Density Dependent Factors

Competition
Predation
Disease
Parasitism

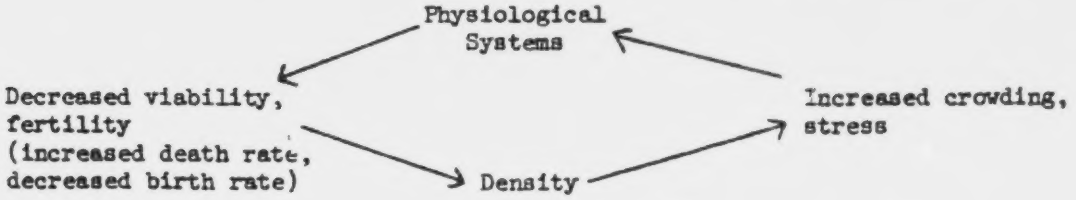


Density Independen Factors

Weather
Habitat Destructio

2. Schools of thought

   a. Not self-regulation: Populations are not self-governing. When optimum environmental conditions are present, they will continue to grow.
   b. Self-regulation: Populations contain intrinsic mechanisms for regulation themselves. These may include density-dependent biotic factors (above) or physiological and genetic feedback systems (below).

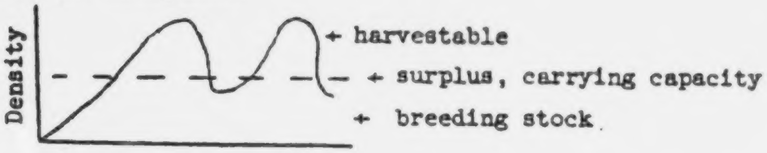

Physiological Systems
Decreased viability, fertility (increased death rate, decreased birth rate)
Density
Increased crowding, stress

c. Comprehensive

	Regulated by:	Density Level:
Density	Mostly density dependent factors	Very high
	Combination of density dependent and independent factors	Usual density
	Mostly density independent factors	Very low

APPLIED POPULATION ECOLOGY

1. Harvest management



2. Human populations

   a. Why are we in the S-curve?
   b. How do we get out?

B-15

Fl. 203

Study Objectives for Assigned Reading (Set 1), and Chapter 4 (Pages 86-91).

Chapter 4 (Pages 86-91)

-Know the pathways and events in the:

1. Carbon cycle
2. Nitrogen cycle
3. Phosphorus cycle

What are the "dead ends" in the cycles? How do humans intervene in each cycle? Why are each of these cycles important to the environment and humans?

-Understand the concept of predation and the ways in which it can be beneficial.

-Also understand the definition of the following interactions between organisms and situations in which they occur:

*commensalism
*mutualism
*competition
*neutralism
*parasitism

Assigned Reading (Set 1)

"Unbridled Growth: A Crisis For Mankind"

-Pick out from the article the negative effects the swelling population has on the world and living conditions.

Maternal Mortality/Infant Deaths

-What can be done to cut down on the mortality rates of mothers and children in the short and long run?

Popline

-Look for the U.S. reaction to China's population policies.
-Overall, has the U.S. been a strong supporter of birth control and family planning in developing countries?

CHAPTER STUDY OBJECTIVES - FW 203

Chapter 20

p. 485 in text book. Discussion Questions # 2,3,5,6,7,8,13,18.

Chapter 22

1. Summarize the major events occurring at Love Canal.

2. Describe illegal and improper waste disposal techniques and hazards they can create.

3. How much hazardous waste is produced in the United States each year? How many hazardous waste dumps are there?

4. What are proper and improper waste disposal practices?

5. Describe the three-tier hierarchy of options for handling hazardous wastes. Describe the pros and cons of the major technological controls on hazardous wastes, including process modification, recycling and reuse, conversion to nonhazardous or less hazardous materials, and perpetual disposal.

6. What is the EPA Superfund? When is it used? What are its weaknesses?

Biogeochemical Cycles

I. The Circulation of Materials (finite supply)

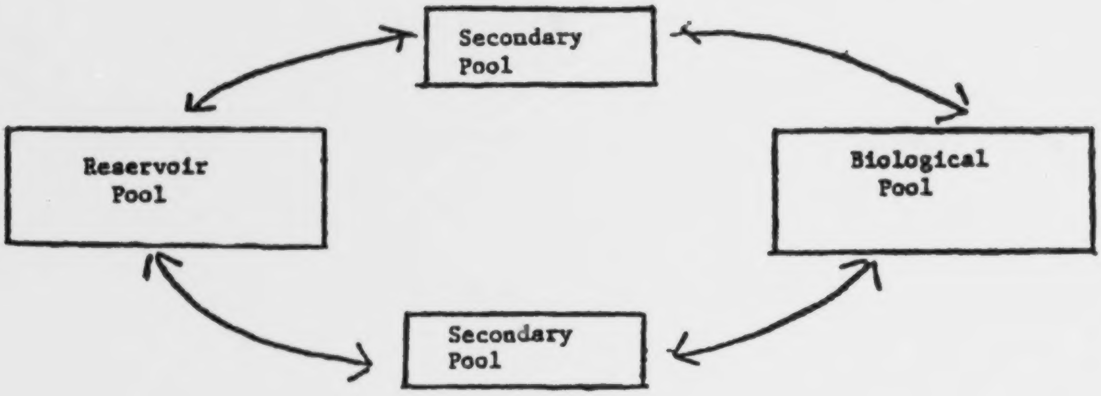
  A. Water

  B. Carbon

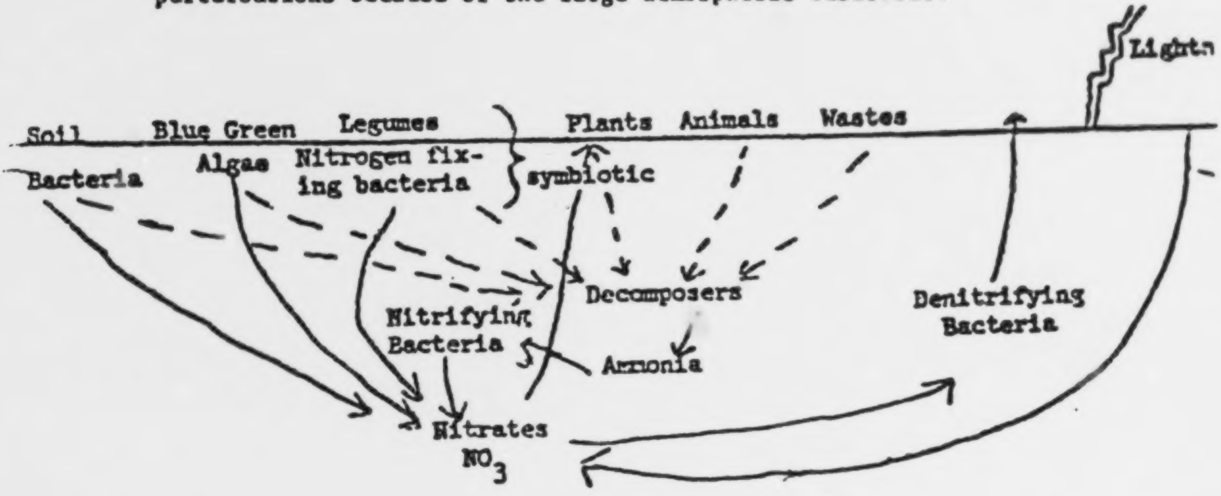
  C. Macronutrients

  D. Micronutrients

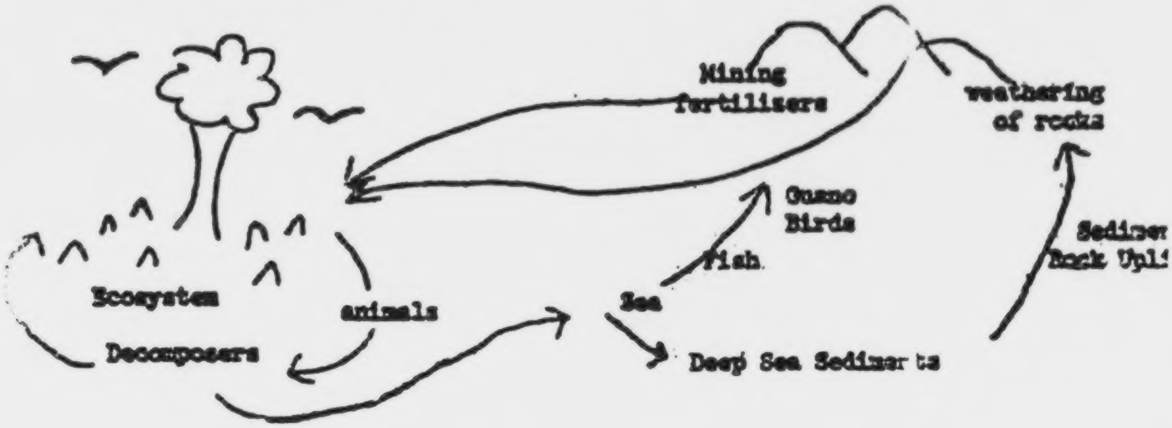
II. A Generalized Biogeochemical Cycle


Secondary Pool
Reservoir Pool
Biological Pool
Secondary Pool

III. Nitrogen Cycle (gaseous or perfect) - self adjust rather quickly to perturbations because of the large atmospheric reservoir.


Lightn
Soil Bacteria
Blue Green Algae
Legumes
Nitrogen fixing bacteria
symbiotic
Plants
Animals
Wastes
Decomposers
Nitrifying Bacteria
Ammonia
Nitrates NO_3
Denitrifying Bacteria

Phosphorus Cycle (sedimentary or imperfect) - are more easily disrupted because the great bulk of material is in a relatively inactive and immobile reservoir in the earth's crust.


Mining
fertilizers
weathering
of rocks
Guano
Birds
Fish
Sedimen
Rock Upli
Ecosystem
animals
Sea
Decomposers
Deep Sea Sediments

Major points about Biogeochemical Cycles.

Higher organisms depend on a few lower organisms

B. Gaseous cycles tend to be in a steady state (input tends to balance output)

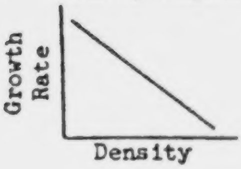
C. Each element or substance has its own circulation pattern

What affects growth rate?

1. Birth rate - fecundity, age structure, age at first reproductive activity (i.e., marriage age).
2. Death rate - age structure, density dependent and independent factors.

HOW ARE POPULATIONS REGULATED?

1. Density dependent vs. independent factors



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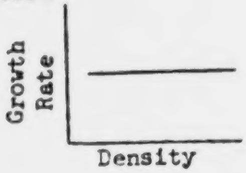

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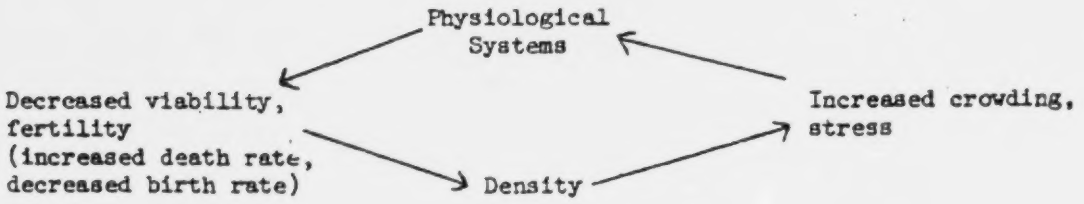
Physiological Systems
Decreased viability, fertility (increased death rate, decreased birth rate)
Increased crowding, stress
Density

   c. Comprehensive

Regulated by:	Density Level:
Mostly density dependent factors	Very high
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Density

V. APPLIED POPULATION ECOLOGY

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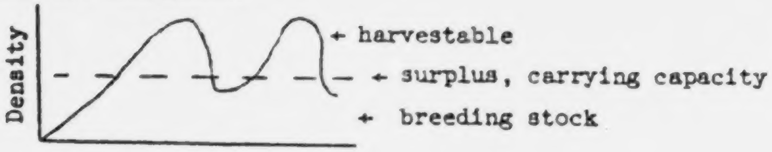

2. Human populations
   a. Why are we in the S-curve?
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on-life Life

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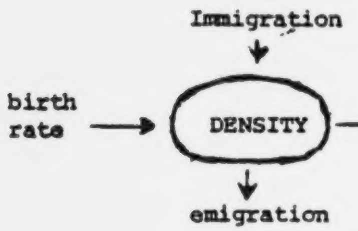
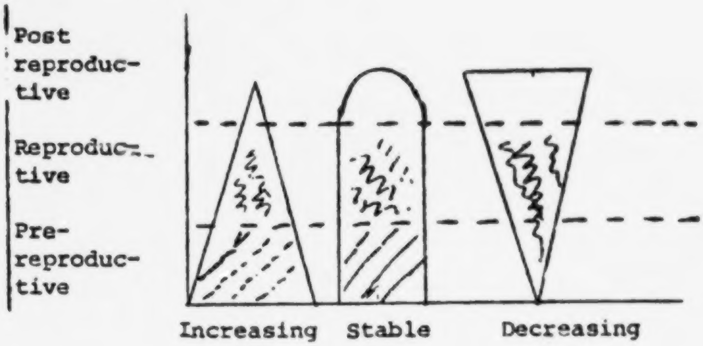

Immigration
birth rate
DENSITY
death rate
emigration


Post reproductive
Reproductive
Pre-reproductive
Increasing
Stable
Decreasing

III. POPULATION GROWTH

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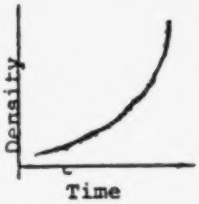
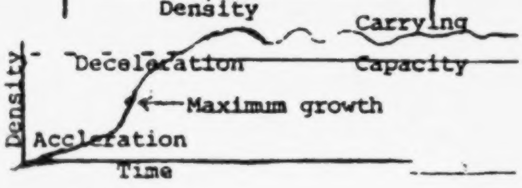


2. RESTRICTED(logistic) growth

$$\frac{\text{CHANGE IN DENSITY}}{\text{CHANGE IN TIME}} = \text{GROWTH RATE X} \left| \frac{\text{Carrying Capacity-Density}}{\text{Density}} \right| \text{X Den}$$



FW 203

"China's Only Child"

Questions to keep in mind while viewing the film:

1. What are the specific problems of China's agricultural base which make continued population growth of particular concern to Chinese authorities?

2. What measures, in addition to the "One Child Policy," will decrease population growth in China?

3. When will population growth in China level out under the "One Child Policy?"

4. What are the means by which couples are convinced to restrict their number of children? Which of these methods might also work in other cultures or societies?

5. Population growth in some European countries has reached, or nearly reached, zero. This has not happened because of a "One Child Policy." Speculate on how ZPG was reached in these societies.

6. Relate China's "One Child Policy" to the current social and economic conditions in the country. How has population density affected "freedom of choice?"

Winter Term 1986
RD 301
M-W-F 10:20-11:10 am
221 Natural Resources

CONSERVATION OF NATURAL RESOURCES

The approaches to and use of the U.S. (and world) natural resources and environmental heritage are receiving a great deal of critical examination, recrimination, and in some instances, rejection. Some of this is well intentioned, well-guided and long-overdue; some however, is opportunistically inspired and poorly guided at best. Concern about and debate on environmental issues is engaged in by scholars and knowledgeable people as well as by fools and activists in search of a cause.

In the university setting we should be able to base our studies and discussions of environmental issues on sets of interrelated bodies of facts, methods of analyses, and value-free interpretations. This is seldom attained--there is much confusion about how resources _are_ used and how resources _ought_ to be used. The basic proposition of this course is that some progress can be made in the elimination of confusion about how resources are used and the resulting clarifications will help provide bases for making decisions about how resources ought to be used.

Man's use of resources occurs within a threefold framework. First, and most obvious, is the _physical_ relationships of man to resources, the relationhips of resources to each other, and the physical attributes of a resource independent of man and other resources. Second, and often less obvious, is the _economic_ structure within which decisions to use resources are made. Third and less obvious yet, is the entire range of _institutional_ elements that conditions man's decisions concerning resource use. Each sub-framework can be considered as a complex set of rules governing the playing of a very serious game--the game is the use of resources in a democratic society.

This course is not designed to fully elaborate every aspect of the threefold framework mentioned above in terms of each resource or potential resource. However, we can explore certain features of this framework in terms of certain types of resources so that several general principles and methodological approaches can be developed for future use and refinement by the student as a citizen-scholar.

Two examinations are scheduled. Quiz 1 is weighted a 40%. The final examination has a weight of 60%.

Text: Enthoven and Freeman (editors). _Pollution, Resources and the Environment,_ New York: W.W. Norton and Company, 1973.

Instructor: M.H. Steinmueller
Department of Resource Development
317 Natural Resources Building
355-3414

RD 301 - Winter 1986

SCHEDULE OF TOPICS

January	6	Introduction
	8	Nonenergy minerals
	10	Energy resources - oil
	13	Energy resources - natural gas and coal
	15	Energy resources - alternative energy sources
	17	Introduction to land resource use
	20	Cropland resource use
	22	Forest land resource use
	24	Forest land resource use
	27	Recreational land resource use
	29	Recreational land resource use
	31	Wildlife and recreational fisheries
February	3	Urban land resource use
	5	Quiz I
	7	Ocean resource use
	10	Ocean resource use
	12	Ocean resource use
	14	River basin development
	17	Rights to use water resources
	19	The Chicago - Lake Michigan Water Diversion Controversy
	21	The Chicago - Lake Michigan Water Diversion Controversy
	24	Water quality considerations
	26	Water quality considerations
	28	Food production - population - environmental concerns
March	3	An historical sketch of environmental eras
	5	Future environmental concerns
	7	Summary and concluding remarks
March	12	FINAL EXAMINATION 12:45 - 2:45 pm

RD 301
Quiz I
SAMPLE February 31, 1999

Read each question carefully. Read each answer carefully. Select one answer per question.

1. The Chicago-Lake Michigan Water Diversion Controversy was resolved by:

   A. Chicago refraining from any more diversion of water from Lake Michigan to the Mississippi watershed.
   B. Michigan and the Lake States giving up their absolute claims to the waters of the Lake Michigan.
   C. The Supreme Court (United States) establishing a decree to which Chicago and the Lake States agreed.
   D. Congress writing new laws and signed by President Eisenhower.
   E. Chicago using Lake Michigan waters and then putting their sewage effluent back into the Lake to maintain the water level.

2. The salmon (Coho and Chinook) are especially appropriate for the Upper Great Lakes aquatic and recreational fishing environment because:

   A. They have relaitvely short life cycles and because they are "artifically" propagated we can easily eliminate them if serious problems occur.
   B. They are relatively easy to catch by recreationists.
   C. They are a "Schooling" fish.
   D. They help keep the alewife numbers in check.
   E. All of the above are correct.

3. The Meadow's study on "The Limits to Growth" in Pollution, Resources and Environment indicates that if or when limits to growth are reached:

   A. There will be a rather sudden and uncontrollable collapse in population and industrial capacity.
   B. An equilibrium or levelling-off of population and economic growth will occur.
   C. A general economic slowdown will occur, with downward trends in population.
   D. Population will continue to increase adding to our misery.
   E. High levels of prosperity will be reached by all.

4. The underlying assumption of the Green Revolution is:

   A. Farmers were not economic men and therefore food crops would have to be grown on government farms.
   B. Jungle areas were the most productive areas of the world for growing food crops.
   C. Photosynthesis in greenhouse type industrial settings was the only way.
   D. Farmers were economic men and would respond to new techniques if other incentives were available for their use at reasonable costs.
   E. Organic farming would greatly advance food supplies in the shortest period of time.

APPENDIX D

Peyton - W/81

FW 435
Env./Cons. Program Design

Performance Objectives

Goal I: Present a set of goals for EE which may be used as a framework for EE curriculum development, selection, or evaluation.

As a function of class discussion, activities, and assigned readings, students will be expected to be able to:

1... explain the meaning of, and defend the following as a superordinate goal of environmental education:

> ... to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

2... describe from memory each of the goal levels proposed by Hungerford et al.

3... describe from memory, 10 ecological concepts which should be included as Goal Level I, Ecological Foundations.

4... describe from memory 5 of the 7 concepts of Level II, and be able to recognize any of the 7 concepts as belonging to Goal Level II.

5... describe in sentence form the meanings of components A and B in Goal Levels III and IV, i.e., how are components A and B different?

6... list from memory the 6 knowledge/skill statements of Level III, component A.

7... list from memory the 2 knowledge/skill statements of level III, component B.

8... list from memory the skill statement of Level IV, component A and the 2 opportunities described in Level IV, component B.

9... understand the meaning and use of the goal statements well enough to analyze a curriculum, unit, or activity to determine the extent of its potential contribution to achieving the goals for EE (e.g., Project Learning Tree).

10.. when given a goal level in a test situation, provide an example (by name or description) of a unit or activity which could potentially achieve that goal level with receivers.

11.. appropriately use the Goal Levels in designing curricular units or activities.

Goal II: Familiarize students with existing EE programs (formal, non-formal K-12, adults) and with past, present, future trends in EE.

As a function of class discussion, activities and readings, students will be expected to be able to...

1... define the following terms, differentiate among them, and describe the contribution each can make to the goals of EE: nature study; outdoor education; ecology; conservation; acclimitization; outdoor recreation.

2... describe the origin, contribution to goals of EE, type of strategy(ies), and appropriate use of the following: (add other programs as discussed in class)

Project Learning Tree
OBIS
Investigation and Action Skills for Environmental
    Problem Solving
U.S. Forest Task Cards (Environmental Investigations)
MUCC Wildlife Program (Jim Ottarson)

3... name 3 national and 2 Michigan organizations dealing with EE.

Goal III Develop student skills in preparing and implementing EE programs.

As a function of class discussion, activities, and assigned readings, students will be expected to be able to:

1... given any of 9 considerations stated in the text (Hungerford, Peyton) describe the advantages and disadvantages of multidisciplinary and interdisciplinary approaches.

2... relate from memory 6 of the 11 guiding principles proposed at the Tbilisi Conference (Stapp and Cox p. 13); or given any of the 11, explain its meaning, defend the principle, and provide an example.

3... given any of the 12 learning theory generalizations, (Stapp, p. 12) explain the implications of the generalization for EE curriculum design and provide an example of its application; or when asked, relate from memory the 4 most important of these 12 and defend your choices.

4... apply the 12 generalizations correctly in designing a curriculum or activity or when evaluating an existing curriculum or activity.

5... relate the 3 generalizations about transfer of learning (Hungerford, Peyton, p. 15) from memory.

6... in essay form, defend transfer of learning as an important concern of environmental educators.

7... apply the principles of transfer in preparing or evaluating EE curricula or activities.

8... define and differentiate "curriculum scope" and "curriculum sequence".

9... describe from memory and explain the meaning of the conceptual scope and sequence model for EE in Hungerford, Peyton (p. 38).

10.. reproduce from memory the Curriculum Development and Instructional Process Model (Hungerford-Peyton, p. 26).

11.. explain the function(s) of each component in the model above.

12.. apply the guidelines for curriculum development in designing instructional units which are:
  a) internally consistent (i.e., goals, objectives, strategies, etc).
  b) defensible in terms of EE goals.
  c) appropriate in content, strategy, and means of evaluation to the targeted receiver groups.
  d) complete (thorough)

13.. prepare performance objectives which contain the essential components (ABCD or what, how, how much), and which are clear, measurable, and feasible.

14.. evaluate performance objectives and identify, describe, and improve any weaknesses in the performance objective statements.

15.. define cognitive, affective, and psychomotor domains and give examples of objectives which belong to each domain.

16.. state the 6 categories of the cognitive domain objectives and for each category, give an example of an objective. Further, given objectives, classify them into the categories correctly.

17.. perform the above task for the 5 categories of the affective domain.

18.. in essay form, describe (from memory) and defend the proper use (representation) of the categories of objectives when designing EE curricula, units or activities.

19.. when asked to state a concept, describe it in a complete sentence form which defines a complete idea, functional in preparing or teaching EE.

20.. from memory, list and describe (in less than 3 sentences each) 10 constraints to developing, implementing and evaluating EE programs (Stapp & Cox, pp. 6-8).

21.. given any of the constraints above, describe in a full page essay, a strategy for overcoming the constraint.

22.. describe a set of prodedural guidelines for developing an EE curriculum based upon one or both of the procedures outlined in your texts (Stapp and Cox, p. 8+; Hungerford and Peyton, p. 31+). Your description should identify, define, and defend (i.e., describe the purpose of and need for) key procedural steps.

23.. provide evidence of their own ability to perform the procedures in Hungerford and Peyton: III; IV; V; VI; VIII (p. 31-32).

24.. describe the strategy and give an example of the following teaching models: 1) teacher-directed case studies; 2) student directed case studies; 3) values clarification; 4) Bank's Inquiry Model; 5) moral dilemma model.

25.. describe the outcomes and weaknesses of the models above and describe instances where each might be used effectively to achieve the goals of EE.

26.. describe how measurement and evaluation processes are distinctly different, yet related (Hungerford & Peyton, p. 57).

Goal IV: Provide opportunity for students to improve their knowledge of environmental issues, environmental actions, and ecological foundations.

As a function of class discussion, activities, and assigned readings, students will be expected to be able to:

1... state from memory, define, and give 2 examples each of 6 modes of environmental action.

2... describe a set of criteria for selecting environmental actions which should be taught to citizens.

3... differentiate between environmental problem and environmental issue.

4... state three current Michigan environmental issues and give 2 conflicting value positions for each of them.

5... for each issue above, describe the resource(s) involved, (e.g., location, usefulness, limits, fragility, vulnerability etc.).

6... for each level - organism, population, community, ecosystem - give a definition and a Michigan example.

7... for each level above, state one ecological principle and a Michigan environmental problem or issue in which the principle is involved.

8... given an environmental issue to investigate, identify the key variables in the conflict (e.g., social, economic, ecological).

9... in the issue above, identify, describe and evaluate (using the action criteria of IV 2) two alternative solutions.

FW 485 (W/81)

Env/Cons Program Design

Course Agenda

Session I
Jan 13

... Intro to course and texts

... Defining Goals for E.E.

... Defining Formats for E.E. (Formal, Non-Formal, K-12, Adult Ed)

... Analysis of an E.E. Model: Case of the Bighorn Sheep

... Intro to Curriculum Models

Session II
Jan 20

... Analysis of an E.E. Model: Project Learning Tree

ASSIGNMENTS DUE: Hungerford - 3-24B; Stapp- 3-30
Worksheet (Case of the Bighorn Sheep)

Session III
Jan 27

... Competencies for Effective E.E. Teachers

... Educational Foundations in E.E.

Learning Theory

Knowledge/Attitude/Behavior Relationships

Values Clarification

ASSIGNMENTS DUE: Project Learning Tree Assignment
Reading - Miles ("The Study of Values...")

Session IV
Feb 3

... Ecological Foundations

... Environmental Issues: Investigation and Action

Session V
Feb 10

... Mid Term

... Case Studies: Review of Mich. Env. Issues

... Community Resource Use

Session VI ... Educational Methods in E.E.
Feb 17

Planning Programs

Writing Performance Objectives

... Work Session: Organizing Team Reports

ASSIGNMENTS DUE: Community Resource Inventory
Hungerford - 25-46

Session VII ... Educ. Methods in E.E.
Feb 24

Writing Perf. Object.

... Work Session: Organizing Team Projects

ASSIGNMENTS DUE: Performance Objectives Worksheet

Session VIII ... Implementing the E.E. Program
Mar 3

. Evaluating the E.E. Program

... Inservice Training

... Team Reports on E.E. Program Development

ASSIGNMENTS DUE: Hungerford - 47-62

Session IX ... Team Reports on E.E. Program Development
Mar 10

FINAL - March 17 8-10 p.m.

ASSIGNMENTS

1. Analysis of an E.E. model (Case of the Bighorn Sheep).
   Worksheet provided. Due January 20. 25 Points

2. Analysis of ... (Project Learning Tree)
   Worksheet provided. Due January 27. 50 Points

3. Team Projects

   Teams of 4 to 5 people will assess the interests and competencies of their group and develop a comprehensive curriculum. If the curriculum is for traditional school situations (K-12), the team must identify Basic Concepts and Content areas for each of four grade group levels: K-3, 4-6, 7-9, 10-12. The team has the option of modifying the assignment to serve the needs of a public or private nature center dealing with K-12 and/or adult populations, or to serve some non formal population. In the latter case, the team should confer with the instructor to establish guidelines.

   In addition, each team will develop a program around one major content area of BASIC CONCEPT, with each member of the team developing and presenting (orally) a teaching unit that will contribute to the team program. Teams will be expected to clearly state the Basic Concept to be developed and show how each of teaching units developed are related and part of one conceptual scheme. Each team will have a maximum of 45 minutes for presentation and discussion. Organize your team. Plan 3-5 minutes to present your curriculum, 5-8 minutes for each teaching unit and at least 5 minutes for questions/discussions.

   Due March 3, 10. 50 Points

4. INDIVIDUAL WRITTEN REPORTS: Each individual will develop two programs: one program with two (2) teaching units at same age level, and one program with three (3) teaching units, each at a different age level. (Example: 4-6, 7-9, 10-12 grade levels.) All teaching units are to follow the required format showing age level, concept to be developed, etc., as shown on Sample Teaching Unit Outline. In addition, a list of well written performance objectives representing appropriate cognitive and affective levels should be inserted after the "Purpose" section. Reports should include a copy of your team curriculum organization showing where and how your two programs fit into the overall Program Design.

   Due March 3, 10 100 Points

5. Student Choice

You may elect to do either of the following assignments.

Michigan Environmental Issue/Problem Summary

Select an environmental issue/problem in Michigan about which you would like to learn more. Investigate it sufficiently to prepare a 2-5 page report including the following:

a. Problem statement which defines the problem/issue.

b. Brief historical sketch which traces the problem's origin.

c. Summary of all value positions impinging on the issue and what groups in society hold those values.

d. Summary of knowledge base -- i.e. what we all agree we know; what we disagree about knowing; what we need to know.

e. Summary of the extent, seriousness, and possible consequences of the issue.

f Summary of past, present, and expected actions (and results) taken by groups (legislative, political, etc.).

g. Summary of key proposed alternative actions (solutions) and a brief evaluation.

h. References.

Due February 17 50 Points

Community Resource Inventory

Select some community resource which could be used to achieve goals of E.E. with students (any age). Prepare a 1-2 page report with the following sections:

a. Name of Resource

b. General description of the resource (e.g., location, size, etc).

c. Suitable age group.

d. Major concepts, attitudes, skills which could be achieved.

e. Suggested performance objectives.

f. Suggested activity (brief).

g. Pre (and post) trip preparation necessary.

h. Logistics of site use (limited group size: contact person for arrangements, bathroom facilities, lunch, etc.).

i. References (for the instructor: films: filmstrips: etc.).

Due February 17. 50 Points

Course Evaluation

Assignments	225
Mid term aprox	100
Final aprox	100
Total aprox	425

Grades will be determined by accumulated points on exams and assignments according to the following percentages:

95% and above = 4.0

91% - 94% = 3.5

87% - 90% = 3.0

82% - 86% = 2.5

77% - 81% = 2.0

72% - 76% = 1.5

67% - 71% = 1.0

E N D